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CONTENTS

Original Papers	Page
The genesis of atypical ocular coloboma. Benjamin Rones	883
The embryological basis of cyclopia. Howard B. Adelmann	890
The reptilian retina. G. L. Walls	892
Studies on vascularization of the cornea. L. A. Julianelle and Harvey D. Lamb	916
Fistula at limbus (scleromalacia perforans). C. T. Eber	921
Technic of electrocoagulation in the treatment of retinal detachment. Luther C. Peter	924
Conservative treatment of massive cystoid following cataract extraction. Burton Chance	929
Keratoplasty. Ramon Castroviejo	932
A case of choroidal atrophy without night blindness. Isaac Hartshorne	945
1934—the semicentenary of local anesthesia. James E. Lebensohn	949
Notes, Cases, Instruments	
A modification of the Haitz charts. Charles E. Walker	953
Orbital foreign body. Delamere F. Harbridge	953
Society Proceedings	
Minnesota, Philadelphia, Chicago	956
Editorials	
Professional publicity; Dangerous hypnotics; Photography and ophthalmology	967
Book Notices	971
Abstract Department	972
News Items	993

For complete table of contents see advertising page V

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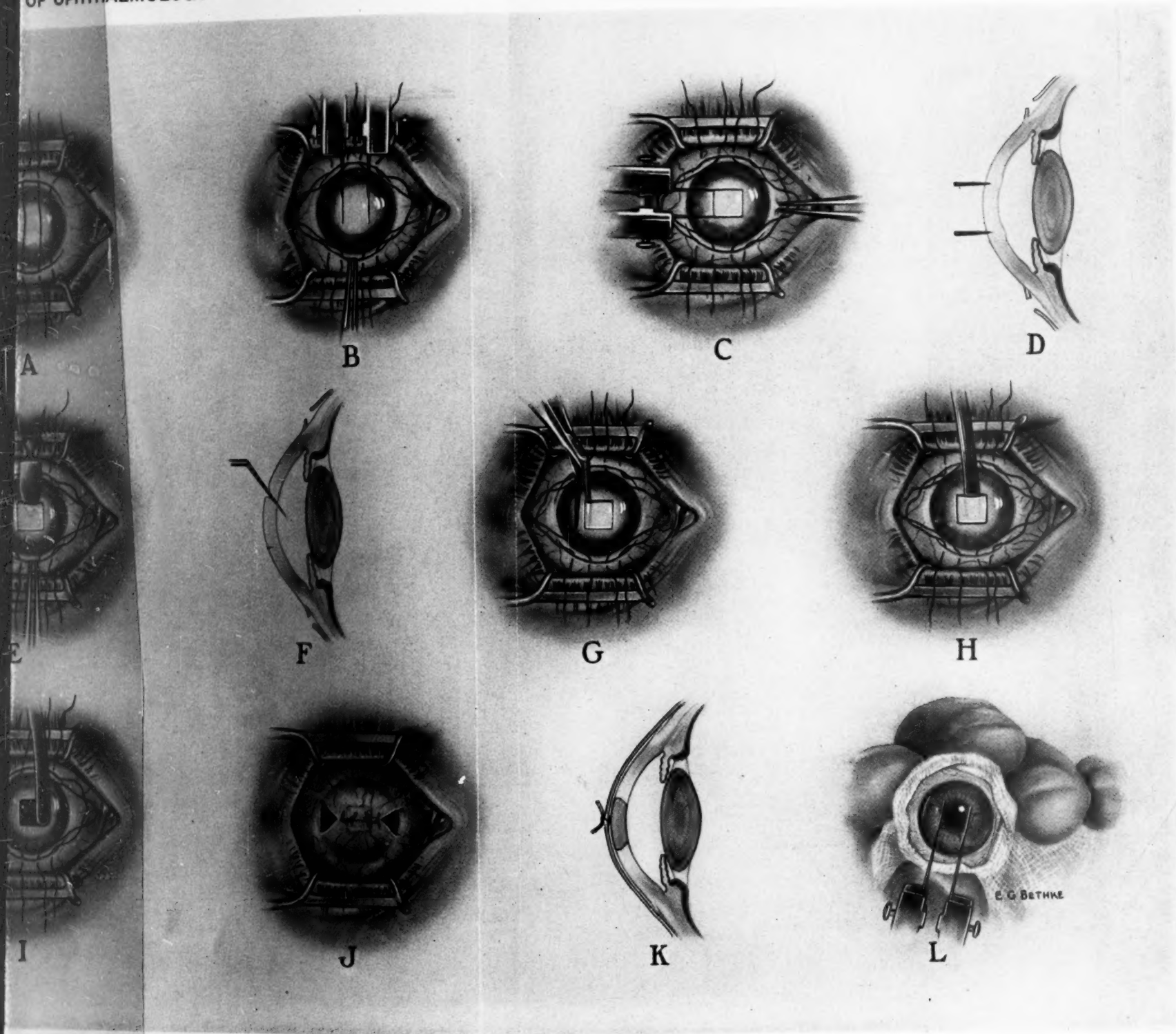

FIG. 3 (CASTROVIEJO). THE SUCCESSIVE STEPS IN THE AUTHOR'S KERATOPLASTY OPERATION.

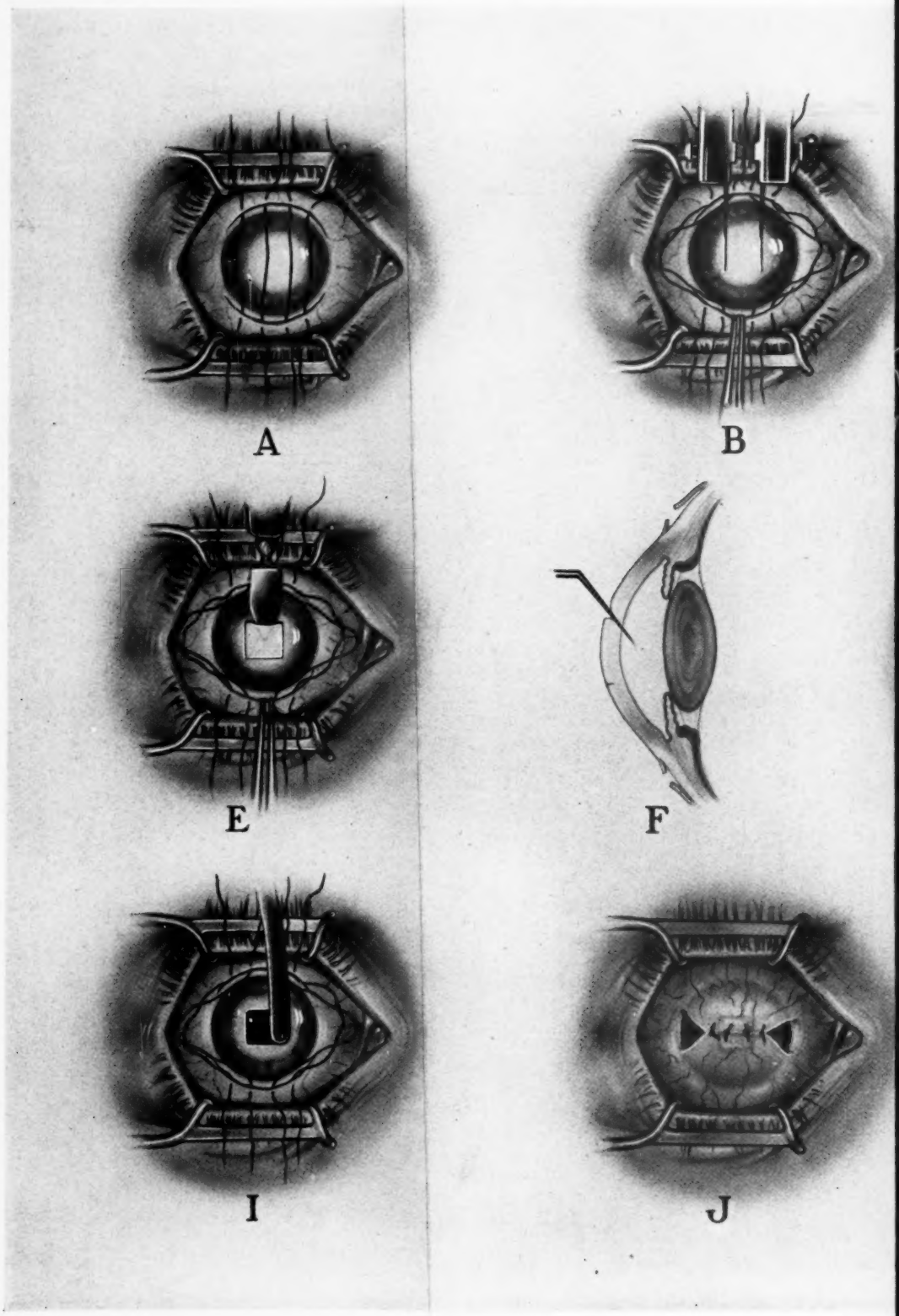

FIG. 3 (CASTROVIEJO). THE SUCCESSIVE STEPS

UNIV. OF MICH.

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THE GENESIS OF ATYPICAL OCULAR COLOBOMA

BENJAMIN RONES, M.D.
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After studying careful reconstructions of the optic vesicle of the human embryo, the author concludes that growth is by spurts, or waves of tissue energy, and that atypical colobomata have no relation to the closure of the fetal ocular cleft, but result from loss of this growth energy in the tissue at the site of the coloboma, the adjacent tissue growing forward, and connective tissue, if present, attempting to fill up the defect. The time when this lag in tissue growth occurs in the development of the eye determines whether the gap is shallow or deep, whether it involves the choroid and ciliary body or the iris only.
From the Wilmer Ophthalmological Institute and the Carnegie Embryological Institute. Presented before the Association for Research in Ophthalmology, in Cleveland, June 12, 1934.

Colobomata, or defects, of the eye have been classified into "typical" and "atypical" with respect to their relationship to the fetal ocular cleft. Typical colobomata are those resulting from a partial or complete failure of closure of the fetal cleft. Seefelder[1] demonstrated that the closure of the cleft began in its mid portion, and extended proximally to the optic stalk and distally to the cup margin. Interference with this normal method of closure results in a proportionate coloboma; if no closure takes place, we have a resultant total coloboma, involving the iris, ciliary body, choroid, and optic nerve. Defective closure of the posterior part of the cleft would lead to coloboma of the optic nerve and adjacent choroid, while failure of closure anteriorly would produce a coloboma of the iris. Various combinations of these positions can also occur, depending upon closure at one or two various points along the cleft. However, all of these defects have one common characteristic; i.e., their relationship to the fetal ocular cleft. Since the position of this cleft is a constant one, on the ventral surface slightly towards the nasal side, the typical ocular colobomata all assume this direction.

The origin of such typical colobomata has been studied in dogs by v. Hippel[2], v. Szily[3], and Seefelder, all of whom believed that, because of a growth of vascular mesoderm through the fissure into the vitreous space, an eversion of the fissure margins was produced, preventing their fusion. The choroid could not develop over this gap in the optic cup.

The problem involved in the causation of atypical colobomata, however, has not been solved as yet. The most frequent variety of this type of defect is that involving the iris, and this resembles the typical form in all respects other than that of position. Bock classified a series of atypical colobomata, in which 14 showed the defect directed outward or up and out, 11 inward, 10 upward or in and up, and 4 downward and out. The group collected by v. Hippel showed about the same relative frequency. Cases have been reported in which two iris colobomata were present in the same eye. Those reported by v. Ammon[4], Manz[5], Macrocki[6], Cosmettatos[7], and Bock[8] showed one coloboma to be of the typical type, while the other in the same eye was of the atypical type. In the cases reported by Mooren[9], and Jensen[10], both colobomata in the same eye were atypical. Rössler[11] has described a case with a typical coloboma in one eye and an atypical form in the other eye.

In view of the fact that the typical colobomata are so definitely related to the fetal cleft, many attempts have been made to relate the atypical form to the same locality. The chief effort was

that of Vossius[12] who in his rotation hypothesis, postulated that a rotation of the eye during growth could cause variations in the position of the fetal cleft. There were never definite grounds to support this view, even though Keil[13] carefully traced the change of position of the embryonic optic organ from its dorsal position to a ventral one, and attempted to demonstrate a rotation phase.

In 1858, v. Ammon[4] reported accessory clefts in the optic cups in two chick embryos and in a sheep embryo, but considered them simply as developmental anomalies. It remained for van Duyse[14] (1901) to point the way in the proper direction. In a 13.5-mm. calf embryo, he found a second cleft in the optic-cup margin, passing downwards and outwards and joining the fetal cleft at the margin. This "fente foetale atypique" he regarded as an atypical optic-cup fissure, which, unlike the ventral fissure, contained no vessels. He believed that these atypical clefts could remain open and give rise to atypical colobomata. A similar observation in a 4-weeks-old human embryo was made by v. Szily[3] (1907), who called it "coloboma of the optic cup not associated with the fetal fissure." According to this author, such defects were due to the mechanical pressure of blood vessels passing over the optic-cup margin and hindering the growth at those points. In v. Szily's case both optic cups showed a depression on the nasal side of the fetal fissure, running for a short distance towards the nerve. In his opinion, these accessory clefts are always anterior, and thus could not be the cause of choroidal defects, though they do account for coloboma of the iris and ciliary body. Wolfrum[15] described a 5-weeks-old embryo in which the optic-cup margin showed three depressions other than the fetal cleft. In all of these clefts he found blood vessels, but he differed with v. Szily in that he thought these vessels to be so delicate and fragile that they could not possibly offer any resistance to the growth of the cup margin. He believed the fissure to be due to a variation in the growth energy of various portions of the cup margins, so that some regions grew at a faster rate than those immediately adjacent, and thus caused such irregularities. Wolfrum also found accessory notches in the cup margin in a number of rabbit and pig embryos in the early stages, but these later disappeared. None of these was of the same depth as in the human embryo. Seefelder could not find blood vessels constantly in the notches, and concluded that this could not be the primary cause of the retardation. All of these authors believed, nevertheless, that such clefts were atypical and were probably the forerunners of the atypical colobomata.

The observations of all these contributors were made upon isolated human embryos or upon a series of animal embryos. It remained for Lindahl[16] (1912) to be the first to study a series of human embryos in order to determine the frequency of accessory notches in the optic cup and relate them to the atypical colobomata. Lindahl utilized the embryos of the lower vertebrates, birds and lizards, together with his human material. Using the method of Born, he reconstructed the optic vesicles of human embryos ranging from 3.4 to 31.1 mm. in length, and of animal embryos in the same stage of development. As a result of this study, Lindahl disagreed with the previous contributors to this subject. He did not consider that the small accessory notches were an exceptional occurrence. In all of his reconstructions he found that besides the optic-cup fissure there were four accessory notches, arranged symmetrically in such fashion as to give the pupillary opening a five-sided shape. He thus differs with v. Szily's assertion that these notches can occur at any point on the optic-cup margin. According to Lindahl, these notches close in the same manner as does the fetal fissure. If, however, anything occurs to prevent their closure, atypical colobomata result. His conclusion is worthy of note. Whereas all previous observers had regarded these accessory notches as a rare anomaly, Lindahl concludes that they are a transient phase in normal development, and that only

when their closure is prevented do abnormal changes occur.

In an attempt to settle this difference of opinion as to the constancy of these accessory notches of the optic-cup margin, and as to their relationship to atypical colobomata, I have made use of the large collection of human embryos in the Department of Embryology of the Carnegie Institute of Washington for this study.

Technic

The routine technic of the Carnegie Laboratory calls for the mounting of the embedded embryo upon the microtome in such fashion that orientation notches are present upon four sides of the block. The surface of the block is first photographed, then the section is cut. Thus with each section, another photograph is taken, so that a series of films results, each one showing the orientation notches. Bromides are made from these films, and orientation lines drawn between the notches. In order to obtain a reconstruction, it is necessary only to pile these plates one upon another, with their orientation lines corresponding.

In reconstructing the optic vesicle alone, the dimensions of the vesicle were measured off from the lines of orientation and transferred to graph paper. This process was carried out upon every section of the series, so that when the measurements were piled one upon the other on the graph paper, an accurate reconstruction of the optic vesicle resulted. Since the bromides showed an enlargement ×100, this same magnification applied to the reconstruction.

Observations

Specimen No. 617, from a human embryo, 7 mm. in length (fig. 1).

The ventral fissure has closed in its posterior portion, but the anterior one third is still widely open. There is a wide, accessory notch two thirds the width of the ventral fissure in the upper inner direction, extending back about one half the distance to the equator. Another, shallower notch is directed horizontally inward.

Specimen No. 3216, from a human embryo, 6.5 mm. in length. (fig. 2).

Fig. 1 (Rones). From a human embryo 7 mm. in length. ×50.

Fig. 2 (Rones). From a human embryo 6.5 mm. in length. ×50.

Fig. 3 (Rones). From a human embryo 8 mm. in length. ×50.

Fig. 4 (Rones). From a human embryo 8.3 mm. in length. ×50.

Here the ventral fissure is still widely open in its anterior one third, but the gap is not so wide as in the previous specimen. The accessory notch on the temporal side is quite wide, though it does not extend very far backward from the cup margin.

Specimen No. 792, from a human embryo, 8 mm. in length (fig. 3).

The ventral fissure is open only in its most anterior portion, thus forming a notch in the lower cup margin. There is only a suggestion of accessory notch formation down and outward, and directly inward. This is caused by a definite deepening of the pupillary space in these regions, though there is no sharp indentation present at either point on the cup margin.

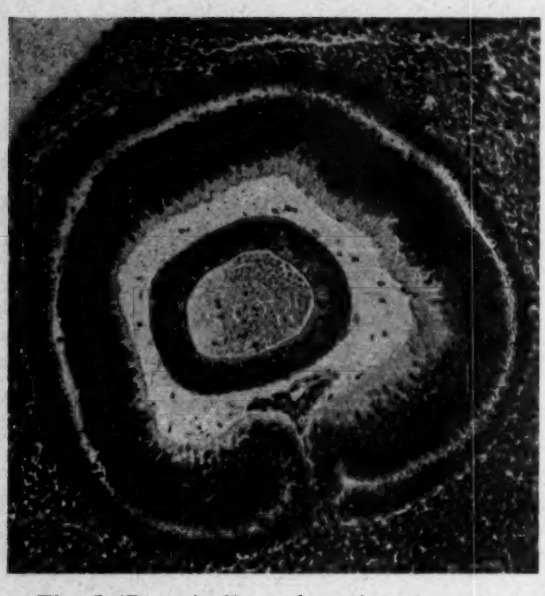

Fig. 5 (Rones). Frontal section through the optic cup.

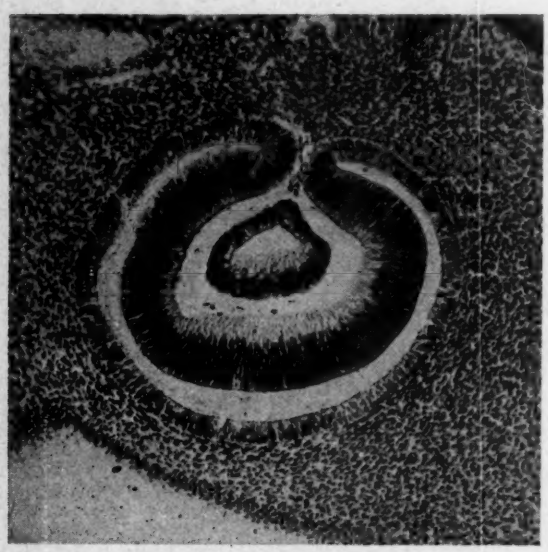

Fig. 6 (Rones). Frontal section through the optic cup.

Specimen No. 3385, from a human embryo, 8.3 mm. in length (fig. 4).

The pupillary space here resembles those reconstructed by Lindahl, though the notches are deeper than in his specimens. The ventral fissure is still widely open in its most anterior portion. There is a deep notch down and out, extending slightly more towards the equator than does the ventral fissure. Another notch up and out is shallower but wider than the other. The optic-cup margin thus takes a lobulated appearance.

The reconstruction of these four optic cups shows without a doubt that deep notches do occur in the cup margin. These notches also occur in a variety of positions, and do not conform to the pattern demonstrated by Lindahl. In view of the difference between these reconstructions and those of Lindahl, it is necessary to seek for some explanation that would account for the uniformity of pattern found in Lindahl's specimens. This can be found in the method of reconstructions that he employed. In using the technic of Born, wax plates are cut for each slide, and these are then piled one upon the other to produce the reconstruction. Unless great care is taken in orienting the specimen, inaccuracies of reconstruction are easily introduced, for the plates will fit one upon the other without reproducing the exact outlines of the embryo. By this method it is almost impossible to avoid producing a pattern that does not fit a preconceived idea, and yet one would be unaware of following a system of error. To anyone who has dealt with reconstructions, it will be perfectly obvious that Born's method, though excellent for reproducing the general outlines of an embryo, is nevertheless far from an ideal method of demonstrating finer details. In my own reconstructions, I have attempted to follow the orientation lines with great exactitude and thus to make sure that the sections were properly piled one upon the other, not only with respect to extent but, more importantly, with regard to direction.

Now that the occurrence of accessory clefts in the optic-cup margin has been definitely demonstrated by the above reconstructions, their causation can be

discussed. Von Szily believed that such notches were produced by the pressure of blood vessels, these vessels being the anastomoses between the hyaloid artery and the ring artery around the optic-cup margin. Van Duyse had found no vessels in the cleft in his case. Wolfrum noted the presence of vessels in the clefts, but considered them too fragile to exert pressure that would retard the actively growing cup margin. I am presenting a series of sections of the embryonic optic cups in various planes, and from these will attempt to evaluate the causative factors.

Figures 5 and 6 represent frontal sections through the optic cup. It is to be noted that the entire cup is surrounded by a rather closely packed syncytium of mesodermal cells, which is richly vascularized. In each of the sections the mesoderm can be seen growing in through the ventral fissure to the future vitreous space. In the longitudinal section in figure 7, the mesoderm which has grown in through the ventral fissure can be seen to have united with that which has grown over the lower cup margin so that it completely surrounds the lower lip of the cup. The persistence of this mesoderm is the factor generally cited as being the cause of the failure of closure of the ventral fissure. Figure 8 represents a transverse section and shows the manner in which the mesoderm passes over the cup margin into the vitreous and surrounds the lens. It can be noted that one side of the cup is more developed than the other. Though the blood vessel (A) is directly over this shorter portion of the cup, it is inconceivable, both from its fragility and from the separating space, that it would be exerting a retarding pressure upon the cup margin. Also the mesoderm over the shorter arm of the cup does not appear to be denser than that over the longer arm. Again in figure 9 we have one side of the cup more developed than the other, with a rather loose growth of mesoderm over both sides. Figure 10 also shows a blood vessel (A) in the mesoderm over the shorter side, but here also there is no evidence that pressure is being exerted by it upon the cup margin.

Study of these sections makes me disagree with v. Szily's theory that the clefts are due to pressure upon the cup margin by the blood vessels. It must be borne in mind that although there is a definite system of hyaloid and ring arteries, nevertheless the entire mesoderm surrounding the optic cup is a richly vascularized tissue of a rapidly proliferating nature. As in all embryonic tissue, there is a constantly changing vascular pattern, with the vessels always accommodating themselves to the changes in the tissues, and never retarding growth, but rather changing their course to get out of the way. The

Fig. 7 (Rones). Longitudinal section through the optic cup.

vessels are merely endothelial-lined spaces, with no development of a media or adventitia at this stage. It is inconceivable that they could exert any retarding pressure upon the growth of such a structure as the double-walled optic cup.

The possibility of retardation of growth due to the pressure from bands of mesodermal cells must also be considered. Study of the specimens shows that the mesodermal cells entirely surround the optic cup and push into it through all openings. There is no evidence at this stage that the mesodermal cells are organizing into denser bands of tissue, except in figures 8 and 9,

where there is beginning evidence of condensation of cells around the cup to form the choroid. In the region of the cup margin there is no increased packing together of cells which could be regarded as evidence of compression of the cup margin at any points.

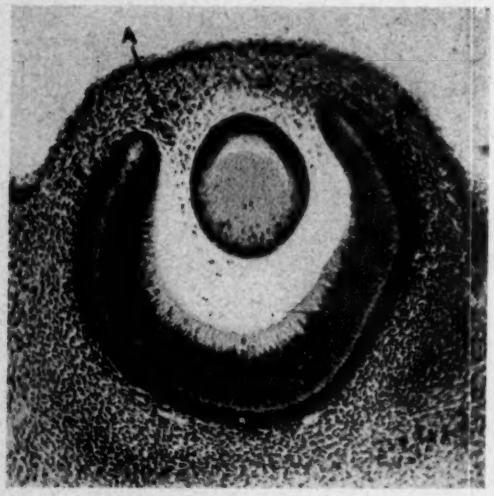

Fig. 8 (Rones). Transverse section through the optic cup.

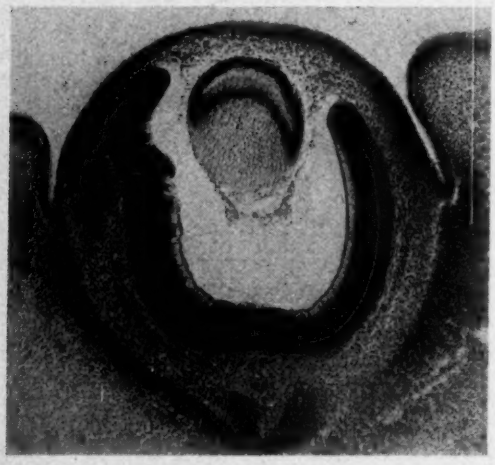

Fig. 9 (Rones). Transverse section through the optic cup.

Consideration of all these factors would thus lead me to agree with Wolfrum that the clefts in the cup margin are not retardation phenomena, but are primarily due to variation in the growth energy of the cup margin. It would be difficult to conceive that such an actively growing tissue as the embryonic optic cup would present a smooth margin at this stage. As is true of all growing margins, there are "waves of growth" taking place, so that growth is accelerated at one point while the adjacent region lags behind, and then the slower region catches up by an acceleration which travels from one region to the other. It must be remembered that this tissue has a very large growth potential, and is in a constant state of pushing onwards. Though this growth comes in spurts, the resultant organ conforms to a general pattern, the result of the exhaustion of the growth potential and of the conforming forces exerted by the surrounding tissues. This normal variation of growth would account for shallow notches and irregularities in the cup margin, but not for such deep defects as are shown in the above reconstructions, which result in the formation of colobomata; for this, we must seek an explanation. The generally accepted view is that these defects are due to a persistence of the mesoderm, which does not allow the cup margin to grow forwards. Ida Mann has recently attempted to prove this by an examination of atypical colobomata in developed eyes, where she finds mesodermal strands present in the

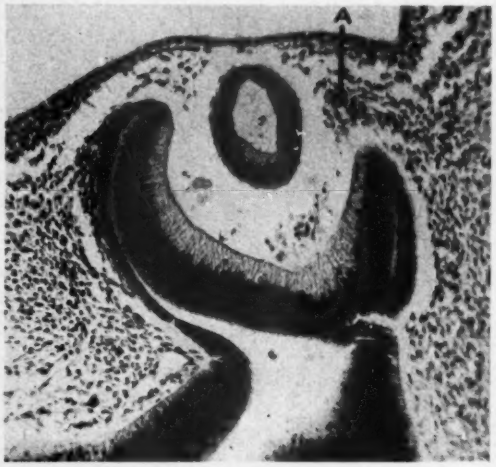

Fig. 10 (Rones). Longitudinal section through the optic cup.

region of the defect, both on clinical examination and on histologic study. The mere presence of connective tissue in these regions, however, does not seem to me to be proof that this tissue has caused the defect. It appears to me to be much more likely that the connective tissue has remained behind in an effort to fill up the defect which has occurred primarily because the tissue has experienced a loss of growth energy at this point. Thus we know that although connective tissue has penetrated through the ventral fissure of the embryonic eye, nevertheless, in the overwhelming majority of cases this fissure closes in the course of growth. When the fissure does not close, it is assumed that this failure of closure is due to the connective tissue. My belief is that here also the connective tissue remains because the fissure has not closed, and has attempted to fill the defect.

We can therefore reconstruct the course of events which leads to the formation of atypical coloboma. The circular margin of the optic cup grows forward in waves or spurts, so that the various adjacent portions spurt forward, then rest, until another burst of growth energy pushes them on again. Now, if, for some unknown reason, one portion of the cup margin loses this urge to grow forward, the adjacent regions will soon be far ahead leaving a defect where the tissue has failed to keep pace. If this loss has occurred at an early stage, it will result in a very deep notch, but if it occurs later the notch will be proportionately shallower. The resultant coloboma thus depends upon the time when this loss of energy occurs, as to whether it will involve the choroid, ciliary body, or only the iris.

Summary

1. Typical ocular coloboma results from a defective closure of the fetal ocular cleft.

2. The origin of atypical coloboma has no relationship to the fetal ocular cleft.

3. Notches occur in the margin of the embryonic optic cup due to variations of the growth energy of the margin, but normally these tend to smooth themselves out by a later equalization of growth and by the conforming pressure of adjacent tissue.

4. The persistence of these notches is due to a loss of growth energy of the tissue at this point, and the growing forward of the adjacent tissue.

5. It is not necessary to presuppose any retardation pressure from either blood vessels or connective tissue in the production of such defects.

6. The presence of connective tissue in these regions can be explained by the compensatory attempt to close the defect.

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THE EMBRYOLOGICAL BASIS OF CYCLOPIA

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Abstract of paper read before the Association for Research in Ophthalmology, in Cleveland, June 12, 1934.

Two opposing interpretations have long existed regarding the position and characteristics of the eye-forming material of the neural plate and earlier stages. Spemann ('04, '12) concluded that two separate eye anlagen with irrevocably determined potencies exist as a mosaic at least as early as the neural plate stage in amphibia. Stockard ('13) concludes that the future eye-forming cells occupy a median position in the neural plate, this median group of cells normally expanding laterally to form two optic vesicles. According to the first interpretation, cyclopia results from the fusion of two separate eye anlagen when the median regions are defective. According to the second, cyclopia arises when the bilateral expansion of median eye-forming material is checked.

This paper reviews experiments on Amblystoma punctatum (spotted salamander) carried out with the view of studying the position and characteristics of the eye-forming regions of the neural-plate stage as the basis for a more satisfactory explanation of cyclopia.

The writer has shown (Adelmann '29, '29a, '30) that:

1. Extirpation of a median circular disc or strip one fourth to one third of the transverse diameter of the neural plate does not prevent the formation of two eves.

2. Extirpation of a lateral third of the anterior end of the neural plate results in the formation of a rudimentary eye on the side of the operation. To prevent completely the development of an eye the lateral effect must extend to the midline.

3. After extirpation of two thirds of the anterior end of the neural plate, the remaining lateral third forms an eye with approximately normal proportions.

4. When median and lateral thirds of the anterior end of the neural plate were transplanted with and without the underlying roof of the archenteron (entomesoderm substrate):

(a) Approximately five times as many eyes were developed from lateral strips transplanted with substrate as without; the substrate evidently reinforces the eye-forming potencies of the lateral regions. Little if any reinforcing effect was noted in the case of median strips.

(b) More than six times as many eyes were formed from median strips transplanted without substrate as from lateral strips transplanted without substrate. The eye-forming potencies of median regions are therefore higher than those of more lateral regions. However, a less pronounced increase was observed in the number of eyes formed for median strips transplanted with substrate as compared with lateral strips transplanted with substrate.

(c) The substrate affects the character of the eyes formed from median strips. Two distinct eyes separated by brain floor were formed in the majority of transplants with substrate; no such cases were observed in those transplanted without. A majority of the latter formed single eyes often resembling cyclopean eyes in their relations to the implanted brain.

It is concluded that the eye-forming materials of the anterior end of the neural plate possess generalized eye-forming potencies, the materials for the two eyes constituting a harmonious equipotential system capable of differentiating into one or two eyes depending upon factors operating during development. While the eye-forming potencies of the neural plate alone are higher in the median regions, the influence of the substrate is responsible for the establishment of two bilaterally situated centers of eye-formation which arise as the materials expand during later stages. If the substrate fails to function normally or the neural plate

is unable to respond to its influence the formation of a single harmoniously differentiated cyclopean eye results.

These results are in harmony with other work of Spemann ('31), Mangold ('31), and others, demonstrating that the roof of the archenteron is responsible for the induction of the neural plate and eye, and are further supported by the author's ('34) study of cyclopean embryos produced by lithium treatment where abnormalities of the prechordal mesoderm and entoderm are correlated with anomalies of the prechordal portion of the cyclopean head.

The nature of the influence of the substrate on the bilateral differentiation of the eyes, whether chemical, mechanical, or a combination of both is still uncertain.

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THE REPTILIAN RETINA

I. A new concept of visual-cell evolution

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The author's concept is that rods and cones are physiological, not morphological entities and that transmutation from cones to rods has taken place when nocturnal habits have been acquired by forms whose ancestors were diurnal and pure-cone. The transmutation from rods to cones has also probably occurred at least once—a tertiary change. Thus, within limits, habits rather than taxonomic position determine the visual-cell pattern displayed by a given form. The bearing of this concept upon the Duplicity Theory is discussed. Read before the Association for Research in Ophthalmology at Cleveland, Ohio, June 12, 1934.

Introduction 892
Material and Methods 894
The Snakes
1. Ophidian visual-cell patterns 895
2. The ophidian double cone 896
3. The diurnal Colubrid retina 897
4. *Hypsiglena* and *Phyllorhynchus* 898
5. Intermediate stages in the pure-cone: pure-rod conversion 899
The Lizards
1. Lacertilian visual-cell patterns 903
2. *Heloderma* 904
3. *Xantusia* 905
4. The geckoes 906
Sphenodon 908
The Turtles and Crocodiles 911
Discussion 913
Bibliography 914

Introduction

This paper is the first of a series which will deal with the description and interpretation of the various visual-cell patterns of reptiles. The hypothesis to be presented here is based upon evidence from several groups of reptiles, so that it has seemed convenient to assemble all of this evidence in a preliminary contribution. Later papers, dealing with particular groups of reptiles, will thus be chiefly descriptive, and needless repetition of theoretical discussions will be avoided.

The familiar Duplicity Theory comprises two major tenets: (1) cones have high thresholds of stimulation and afford sharp vision, while rods are much more sensitive and afford diffuse central images, and (2) cones mediate chromatic vision, whereas rods yield only white-grey-black sensations.

The second of these points is irrelevant to our purpose here. A careful study of the retina as a whole discloses that the first is too simple a statement, for it implies that the differences between rod- and cone-vision are entirely resident in the cells themselves.

If rods and cones be analyzed from the standpoints of sensitivity and visual acuity, it is readily seen that some of their differences, from each of these standpoints, lie in the mode of their extrinsic connections to neurons. It has long been known that rods are connected in numbers—often very large numbers—to single projective bipolar cells, while cones are less diffusely connected and may even have individual, "private" bipolars, as in macular regions.

The effect of this great difference in neurological summation is twofold. It accounts for most of the difference in the photopic and scotopic visual acuities of duplex retinae, the respective diameters and relative numbers of the rods and cones being actually minor modifying factors. It also accounts partly for the greater sensitivity of the rod population as a whole, for, due to summation, rod bipolars may be set into function in intensities too low for the operation of cone bipolars.

The tangible *intrinsic* factors which govern the brightness thresholds of rods and cones are of course two: (1)

the presence of the sensitizer, rhodopsin (visual purple), in dark-adapted rods and its absence at all times from cones; and (2) the amount of photochemical activity evoked by a light-pencil of given diameter and intensity—a corollary of the volume of the percipient organelle, the outer segment.

The *shape* of an outer segment is almost invariably a passive reflection of its volume. If the organelle is to have a high threshold, as in cones, it must have minimal volume and will necessarily take a conical form unless, as rarely occurs in cones, the inner segment is excessively slender and the cones are very tightly packed (as in the human fovea). If the outer segment is to carry on a maximum of photochemical activity and thus have a low threshold, as in rods, it must have maximal volume[1] and will therefore take the cylinder or prism as its final form. Visual elements with equal basal cross-sectional areas will admit equivalent light-pencils, and, other things being equal, the cell with the more massive (i.e., longer and more nearly cylindrical) outer segment will make fuller use of the actinic power of the available light and will respond to the lower intensity. The basal diameter of an outer segment is fixed by the minimal visual acuity the animal can tolerate, and its length is fixed by the trophic requirements of the more vitread-lying tissues, which are ordinarily supplied through the bacillary layer from the choriocapillaris. Thus, volume is often variable only by varying form, which explains the almost unexceptional shape-differences of rod-and-cone outer segments—a difference so conspicuous as to have given the cells their names in the first place.

The factors which endow a rod population with its great sensitivity are, then: (1) the volume of the outer segments, (2) the multiple connection to bipolar neurons, and (3) the presence of rhodopsin.

It is evident that if phylogenetically, in a pure-cone retina, the visual cells should evolve massive outer segments, multiple connections, or rhodopsin, singly or in combination, we should expect their ultimate possessor to be largely or wholly nocturnal and we should be forced to conclude that a partial or complete conversion of cones into rods had taken place.

It has always been considered that since the original sub-Cyclostome differentiation of the rod and cone, these two "fundamentally different" types of cells have remained distinct and have perpetuated themselves, so to say, throughout the ramifications of vertebrate evolution. Changes in habits accompanied by alterations in the relative numbers of rods and cones have of course occurred; but such changes are quantitative and offer no more difficulty to credence than do evolutionary changes in the proportion of leucocytes and erythrocytes. But all cones are believed to be homologous and descendants of the original cones; all rods are thought to be similarly comparable *inter se* and traceable to the rods of the earliest duplex retina. So axiomatic has this appeared that there has never seemed to be any necessity of expressing this concept in so many words. We may, however, refer to this as the "traditional viewpoint."

Since the evolution of strongly nocturnal or strongly diurnal habits from those of an indifferent rod-and-cone ancestor is possible and indeed an oft-accomplished fact—manipulation of rod-to-cone ratios being all that is necessary—the traditional viewpoint meets with difficulty only when confronted with simplex (pure-rod and pure-cone) retinae. Even here the difficulty has seemed slight; thus the conservative retinologist will explain the pure-rod condition of the geckoes and the pure-cone retina of their lacertilian cousins by asserting that the common ancestor of the geckoes and the other families of lizards possessed both rods and cones: the lizards have simply lost the former and the geckoes the latter.

The morphological distinctness and

[1] Rods may be small, as in most Teleosts, but even here the outer segments are cylindrical. The enormous number of rods in Teleosts results in a total volume of outer-segment material, considerably greater than that of the cones.

immutability of rods and cones have been attacked only by Bernard (1900-1902) and Cameron (1905, 1911), and then most unsuccessfully. These authors were led by a complex of artifacts and ridiculous errors to conclude that the cones of Amphibia are merely developmental stages in the formation of rods, and hence not homologous with the cones of other vertebrates. Their theory is thus purely ontogenetic; it is hoped that the thesis to be presented here will not be confused with it. The writer's theory, hereafter to be referred to briefly as the "transmutation theory," is based upon an assemblage of facts which lead logically to the following conclusions:

1. Cones have been secondarily, phylogenetically, transformed into rods during the evolution of a nocturnal habit by forms whose ancestors were strictly diurnal and pure-cone.
2. Such transmutations have occurred many times, independently of each other, so that unrelated forms have convergently attained similar final conditions.
3. Intermediate stages can be seen in extant genera, some of which may be in a dynamic condition with regard to a change in their habits with respect to light.
4. The reverse transmutation—of rods into cones—has probably taken place at least once, and in this case is a tertiary change.
5. Within limits, habits rather than taxonomic position determine the visual-cell pattern which a given form will display.
6. It was practically inevitable that visual-cell transmutation should occur in reptiles, and it is improbable that many cases will be found outside the reptilian group.

If these conclusions be found justified, their bearing upon universal application of the Duplicity Theory is at once obvious. The occurrence of transmutation makes it clear that it can no longer be assumed that all cones are color-perceptive and that all rods are not, for a hue-discriminatory capacity may well have been retained by rods which have been derived from cones[2].

If rods and cones are not rigidly discrete structural entities, and are found to be capable of only physiological definition, it may even seem necessary to discard the terms "rod" and "cone" entirely, as Parsons (see Mann, 1932) has already suggested, though on very different grounds. They are words which carry an implication of morphological differentiation and immutability. If the rods of some animals are found to have unquestionably been derived from the cones of others, it becomes a little clearer that the two types of cells are really physiological, not morphological, entities. Regardless of their form as seen in sections, they are always identifiable, and definable in physiological terms. Perhaps they should be rechristened with names which have only physiological connotations; such words as "photocyte" for cone and "scotocyte" for rod, for example.

The presence of perfectly differentiated rods and cones in a single retina—the duplex condition of most retinae—should not seem an evidence against mutability, for a simplex retina is perfectly adapted to only one extreme of natural illumination. The duplex retina alone permits of plastic adaptation to a wide range of intensities[3], and it is not surprising that the ancient duplex condition has been retained by the majority of vertebrates.

Material and Methods

Excepting in the case of *Sphenodon*, all material herein discussed was obtained by the writer in the living condition, since studies of the pupillary reactions and rhodopsin, and preservation in special retinological fixatives were mandatory.

While only a few species are treated here, it should be understood that they have been chosen for their special re-

[2] The writer hopes to be able, eventually, to make the crucial test of this possibility—examinations of geckoes, and of *Hypsiglena et al*, for hue perception.

[3] Smooth adaptation to intensity change has been carried even further in the "multiplex" retinae of turtles and diurnal birds (see Walls and Judd, 1933).

lation to the present topic from among more than a hundred species of reptiles accumulated for an extensive survey of reptilian retinae. This large series comprises forms carefully selected to represent as many taxonomic and habit categories as possible. Any generalizations made in this paper with regard to retinal patterns in reptilian groups are thus based upon first-hand knowledge[4].

A number of retinal fixatives were tested, and, for the eyes of all types of reptiles, Kolmer's fluid was adjudged superior to any other. The surviving globe was isolated for preservation excepting in the case of such small forms as *Xantusia vigilis*, where the half-head was fixed and decalcified. After dehydration to absolute alcohol, the lens was removed through a wide aperture made by slicing off the cornea with a Gillette blade. The eyes were embedded and sectioned (5, 7.5, 10μ) sagitally by the hot-celloidin method (Walls, 1932a). Mallory's triple connective-tissue stain and Heidenhain's hematoxylin with phloxine were employed. Where necessary to reveal outer segments, some sections were bleached with chlorodioxyacetic acid.

The pupil was observed under various intensities of light. Its behavior, in reptiles, is of prime importance as an index of what may be expected in the visual-cell pattern. Any approach to the "vertical slit" shape of the most strongly nocturnal species is indicative of a corresponding sensitivity of the retina and hence of the relative prominence of physiological rod- and cone-mechanisms (see Walls, 1932b).

The various species whose eyes were large enough were examined for the presence of rhodopsin by a direct method already described (Walls, 1932c), and in negative cases the preparations were always checked micrologically to make certain that the outer segments were actually in the preparation and had not been left entangled in pigment-cell processes when the retina was peeled out. Ether and chloroform were avoided as killing agents because of their solvent action upon rhodopsin, the method of choice being decapitation. The presence of rhodopsin is a certain criterion of the presence of functional rods; indeed, the best definition of a rod we have hitherto had is "a visual cell which contains rhodopsin when dark-adapted."

The prominence of intraocular color filters being an important inverse index of sensitivity (see Walls, 1931; Walls and Judd, 1933), the coloration of the lenses of snakes and of the oil-droplets of *Sphenodon*[5] and lizards was noted; in the latter examinations, apochromatic optics were employed.

The Snakes

1. Ophidian visual-cell patterns. The generalization so often seen, that all snakes have only cones, holds true only for round-pupiled diurnal forms; but it obtains here regardless of taxonomy. The retina of a typical diurnal Colubrine is shortly to be described, but the description pertains equally well to the diurnal representatives of other Colubrid subfamilies and to non-Colubrid diurnal forms (e.g., cobras) as well.

It is in nocturnal snakes that one sees a number of distinct types of retinae. It is not proposed to describe these in detail here, but it can be emphatically stated that with the exception of the primitive Boid retina, the visual-cell patterns of all nocturnal snakes are derivable from that of the diurnal Colubrids. Intermediate stages in the conversions occur in a number of secretive and crepuscular forms, so that there is no hesitation in homologizing each visual-cell type of even the most complex nocturnal retina with one of the three cone types of the basic and central diurnal Colubrid pattern.

[4] Statements in authoritative literature to the effect that all snakes, lizards, and turtles have only cones (see Greeff, 1900, Franz, 1913, and Plate, 1924) are entirely unreliable, for they are based upon outmoded technical treatment of a handful of species, studied mostly in the last century by investigators who ignored both light-habits and classification in choosing their material.

[5] Which has not hitherto been known.

In the primitive and entirely nocturnal family, Boidae, there is a solitary type of single cone and a slender rod, the latter element being very abundant. This pattern is constant in both Boinae and Pythoninae, and is at present incapable of relation either to that of the lizards or to that of the Colubridae. The situation in the osculant *Xenopeltis* is as yet unknown.

Most species of Colubridae—the central family, embracing a vast majority of all serpents—are round pupiled, diurnal, and exhibit a simplex retina containing two types of single cones and a double cone. The structure of the latter is so peculiar, and at the same time so important for an understanding of the evidence for transmutation in snakes, that the next section is devoted to its description.

Various species and genera of secretive and crepuscular Colubrids possess unique retinae, most of which can be considered as tending toward one or the other of the distinctly nocturnal types. The slit-pupiled, strictly nocturnal Colubridae thus far examined fall into two nontaxonomic groups exhibiting, respectively, what will be termed the *Hypsiglena* and the *Tarbophis* types of retinae. The *Hypsiglena* type is pure-rod; the *Tarbophis*-like forms are mostly opisthoglyphs and possess slender rods and greatly elongated cones of both single and double types. The *Tarbophis* retina is thus in a static condition of dark-adaptation[6], and is linked with the diurnal Colubrid pattern through *Farancia* and *Leptodira* as intermediates.

The diurnal Elapidae have the standard pure-cone Colubrid type of retina; nocturnal Elapids exhibit various duplex conditions. The Crotalidae, like the Boidae, are very homogeneous and reveal a constant, complex, rod-and-cone retina much like that of the higher Viperidae. The primitive Viperids, such as *Vipera* and the partly diurnal *Causus*, form links between the diurnal Colubrids and the specialized vipers. In the latter (e.g., *Bitis*) the cone myoids are much elongated, reminiscent of the *Tarbophis* situation, and indicative of a more strongly nocturnal propensity than that of, say, the Crotalidae (whose cones are not thus elongated); this indication is borne out by the habits of the two groups.

The diurnal Colubrid pattern (which occurs also in the diurnal Elapids such as the cobralike *Sepedon*) and the *Hypsiglena* type are the only simplex ophidian retinae. All other nocturnal snakes have rod-and-cone retinae, and all nocturnal Colubridae, Elapidae, Viperidae and Crotalidae have had strictly diurnal, pure-cone ancestors among their Colubrid progenitors. In short, the interpretation of snake retinae is possible only in terms of transmutation; but for the proof of the latter, only what is perhaps the most clear-cut ophidian case of transmutation—the *Hypsiglena* type of retina—has been selected for detailed consideration in this paper.

2. The ophidian double cone. Double cones are visual elements consisting of two complete cones that are fused throughout a greater or lesser portion of the length of their inner segments. They differ from "twin" cones, which occur only in Teleost fishes, in that the members of the pair are very dissimilar, whereas in twin cones they are identical. One member, which resembles closely the single cones of the same retina, is designated the "chief" cone and is migratory if the single cones are migratory. The other, or "accessory" member is quite unlike the single cones and is never extensible.

Double cones appear first in *Amia*[7] and are present in frogs, toads, salamanders, turtles, lizards, snakes, and birds. In all of these forms except the snakes, the double cones are built on the same plan, exemplified in figure 1 by the double cone of the Snapping Turtle.

In only one snake, *Natrix natrix*, have double cones hitherto been described and figured (Hoffmann, 1876). Hoff-

[6] In terms of photomechanical changes, evidence for which has not yet been found in any type of ophidian retina.

[7] Unpublished observations. The urodeles have been generally believed to be the lowest forms possessing double cones.

mann's drawings show a uninucleate element with two outer segments, a structure so very different from ordinary double cones that Hoffmann's work has been tacitly ignored: perhaps considering Hoffmann's cells to have been abnormal of artifacts, authors of reference works (e.g., Pütter, 1912) deny their existence.

So far as they went, Hoffmann's observations were correct; but he failed to see the inner segment and nucleus of the accessory cone. The inner segment is rendered conspicuous in Mallory preparations by the paranuclear body (v.i.) but is easily missed in hematoxylin material. The accessory nucleus is often so far displaced laterally that it seems to belong to a single cone above it. These factors probably account for the failure of others to see the true structure of the ophidian double cone.

Figure 2 shows such an element from two aspects; that it is a unique type of cell is readily seen by comparing figures 1 and 2. It will be noted that in figure 1 the accessory member is massive and the chief cone is slender. The ophidian structure, on the contrary, has a chunky chief cone identical with a single cone, and the accessory is a mere wisp fused throughout the length of its inner segment[8]. The two nuclei are separated—often very widely—and the accessory cone contains a large granular mass. This body, hereafter to be termed the "paranuclear body," is sometimes even larger than the nucleus and is often so closely applied to the latter as to produce a flattened area thereon. The nucleus and the paranuclear body are occasionally enclosed in a common spheroidal lacuna.

The ophidian double cone appears to have evolved since the Colubridae became pure-cone, and after the abandonment of the photo mechanical changes characteristic of the duplex retinae of lower forms, for the manner in which the two members are fused prohibits the independent extension and contraction of the myoid of either of them.

This fundamentally different organization of the ophidian double cone, together with the fact that it is entirely lacking in the Boidae, indicates that this structure, like the twin cone, is unique and not homologous with the double cones of vertebrates in general.

The writer believes that the ophidian double cone was evolved during the differentiation of the Colubridae, and that it has been inherited from them by the higher families, all of which have their roots in Colubrid stock. *Xenopeltis* may prove to have a type of double cone which will reveal the origin of that of the Colubridae, but this is very doubtful in view of the strongly photophobic habits of this form.

3. The diurnal Colubrid retina. Most Colubridae are diurnal, and most diurnal snakes are Colubridae. Since all diurnal Colubrids are pure-cone, and no nocturnal ones show so simple a pattern as that of the Boidae, but rather exhibit complex patterns derivable from the diurnal retina, it can be safely concluded that the diurnal retina is primitive so far as living Colubridae are concerned.

In addition to the peculiar double cone which they share with the higher families, the diurnal Colubrids have two other types of cones (fig. 3). The large single cone, henceforth to be designated "Type A," and the double cone ("Type B") are about equally numerous. The small single cones ("Type C") are always few in number in bright-light forms, are multiplied considerably in some secretive snakes[9], and are suppressed completely in those

[8] Hoffmann seems not to have understood the definitions of chief and accessory cones, for he termed the massive member of the ophidian double an accessory. This error does not, however, affect the truth of his remark that the ophidian double cone exhibits a far greater discrepancy in the size of its two members than any other double cone.

[9] And in duplex ophidian retinae, as will be shown in detail in a later paper, it is the Type C cone which has become a rod. Type C thus appears to be an inefficient photopic cell and, of the three types, it is the one which is most potentially a rod and the first to be converted—the only one, in cases where retention of good photopic vision is vital. Thus while *Hypsiglena* has sacrificed acuity for sensitivity by transmuting all three types, *Tarbophis*, the Crotalidae, etc., have preserved Types A and B as cones and have converted only Type C into a rod.

species whose vision is especially keen (e.g., *Dryophis, Malpolon, Sepedon*).

The staining reactions of these three types are specific and regular from species to species. Type A and the chief member of Type B stain characteristically in Mallory preparations as follows: ellipsoids, yellow; outer segments and myoids, blue; nuclei, orange. Type C differs in that the ellipsoid is purple, indicating some affinity for both acid fuchsin[10] and aniline blue. The ellipsoid of the accessory member of Type B may be deep blue but is often purple or even red; other parts color as in the chief and Type A, the paranuclear body staining especially heavily with aniline blue.

Type C is, assuredly, qualitatively distinct, never intergrading with Type A in any respect. All types are constant throughout the retina but gradually become more plump and less closely set in the anterior periphery. Where a semblance of an area centralis is present, as in *Malpolon*, there is a slight local slenderization of all the visual cells; this becomes profound in the case of the foveal cones of *Dryophis*[11].

The outer nuclear layer is almost invariably single and the footpieces are short and heavy, terminating in a thin outer molecular layer in which the horizontal glial elements are often very heavy, approaching the condition seen in turtles.

The inner nuclear layer contains 7 to 11 rows of nuclei in bright-light forms, with no obvious demarcation into bipolar and amacrine zones in most cases. The higher numbers of inner nuclear rows are associated, as would be expected, with the more strongly light-loving habits. The Müller fibers are ordinary in disposition and numbers; the inner molecular layer shows no peculiarities. The ganglion layer is invariably single[12] and its nuclei are not always so numerous as to be contiguous. The details of these various layers as they appear in different forms will of course be given in a later paper.

4. *Hypsiglena* and *Phyllorhynchus*. The Spotted Night Snake, *Hypsiglena ochrorhynchus*, and the Leaf-nosed Snake, *Phyllorhynchus decurtatus*, are two rare snakes of the southwestern United States. Both are very nocturnal (Van Denburgh, 1922; Klauber, 1928, 1931) with vertical-slit pupils and colorless lenses. The retinae of these forms are very similar; their visual-cell patterns are the same and the following description applies equally well to both species.

There are three types of visual cells which correspond perfectly in relative numbers, structure, and staining properties—part for part—to the three cone types of the diurnal Colubrids; but the outer segments of all are massive cylinders, and there can be no doubt whatever that these visual cells are functional *rods* (fig. 4).

If the origin of this pure-rod retina is to be explained according to the traditional viewpoint, a gigantic coincidence is involved. *Hypsiglena* and *Phyllorhynchus* are certainly not primitive Colubrids. None of their rod types is comparable with that of the Boidae. If a common ancestral retina contained the three cone types of the diurnal Colubrids and the three rod types of the *Hypsiglena* pattern as well, it were remarkable indeed!

The diurnal cone types must have differentiated from a single ancestral cone such as that of the Boidae, a reinvention of double cones being accomplished. The three rod types of *Hypsiglena* might similarly have differentiated from an ancestral rod type. Those of *Phyllorhynchus* must have had a simi-

[10] An affinity for acid fuchsin is so nearly a diagnostic characteristic of ellipsoids everywhere that the fuchsinophobe behavior of the really conspicuous ophidian ellipsoids has led to denials of the presence of these organelles in snakes.

[11] The only snake so far known to have a fovea. The fovea is located in the extreme caudad periphery and is associated with the aphakic area of the keywhole-shaped pupil in binocular vision (see Walls, 1932b).

[12] Excepting in the circumfoveal region in *Dryophis*, where the ganglion layer is naturally piled up. In *Dryophis* the outer molecular layer is relatively thick and, owing to the laterad course of the foot-pieces as a result of the fovea, a Henle's layer is formed *throughout* the retina, as the visual cells never "catch up" with their bipolars.

lar history—independently, of course, for the two forms are not at all closely related. The double rod then becomes a great puzzle, however, for no such element is seen elsewhere in vertebrates excepting in the geckoes, where, as we shall see later, there is equal reason for thinking it to have once been a double cone. There are two possible interpretations of the *Hypsiglena* pattern, between which one must choose:

(1) A single type of rod in an ancestral duplex retina, the cones of which have been lost, has differentiated independently in *Hypsiglena* and *Phyllorhynchus* into three types which fortuitously imitate perfectly the structure, staining properties, and relative numbers of the three cone types of diurnal Colubridae—even to the presence of double rods having the same slender accessory member, separated nuclei, paranuclear body, etc., as the double cone of the diurnal pattern.

(2) *Hypsiglena* and *Phyllorhynchus* have become nocturnal independently and secondarily, and the three rod types have been produced by the direct transmutation of the three corresponding cone types of strictly diurnal ancestral forms.

The first of these possibilities is clearly a most faint one. The second is strongly suggested by the simple comparison of figures 3 and 4. It would not be insisted, however, that the rods of *Hypsiglena* and *Phyllorhynchus* must relatively recently have been cones, were it not for the existence of intermediate conditions. There are genera in which light-habits, visual-cell form and size, contracted-pupil shape, and neurological summation in the inner nuclear and ganglion layers of the retina are all intermediate between the bright-light, pure-cone complex on the one hand and the situation seen in *Hypsiglena* and *Phyllorhynchus* on the other. After the consideration of some of these cases it will seem easier to believe that the pure-rod Colubrids have had strictly diurnal ancestry and that they have become nocturnal secondarily by the only means available to them—the direct conversion of single and double cones into single and double rods.

We shall see that secretive and crepuscular descendants of diurnal snakes have progressively increased the sensitivity of their retinae by increasing the volume of the outer segments and by decreasing the relative number of bipolar and ganglion neurons. These processes have run to completion in the *Hypsiglena* type, whose visual cells have huge cylindrical outer segments and whose inner nuclear rows number only five. Even in *Hypsiglena* and *Phyllorhynchus,* sufficient sensitivity to require a slit pupil and to permit strongly nocturnal behavior has been attained without resort to a sensitizing pigment. Rhodopsin is absent from *Phyllorhynchus,* at least, and after the situations in nocturnal lizards have been set forth it will not seem surprising that the *Hypsiglena* type of retina has dispensed with this device.

5. Intermediate stages in the pure-cone: pure-rod conversion. The process of transmutation has gone only partway in some Colubrids. *Arizona elegans* and *Rhinocheilus lecontei* exemplify such intermediate forms. These species are secretive and are characterized by Klauber (1931) as crepuscular by preference, though *Arizona* has been found active at night; both have colorless lenses.

The visual cells of these two forms and of the strongly nocturnal *Trimorphodon vandenburghi* have massive outer segments which are bluntly conical, and tend to be truly cylindrical only in the case of the Type C cells (fig. 5). These visual cells are thus intermediate between typical ophidian cones and the rods of the *Hypsiglena* type in the form and size of the percipient organelle. They are intermediate functionally in that their thresholds are necessarily lower than those of completely unmodified cones.

The pertinent characteristics of these and some other species are shown in table 1, so arranged as to bring out the progressive adaptation for nocturnality which has the *Hypsiglena* type as its final product. It cannot be too strongly emphasized that the forms included in the table are not mutually closely related. The intergrading they exhibit is

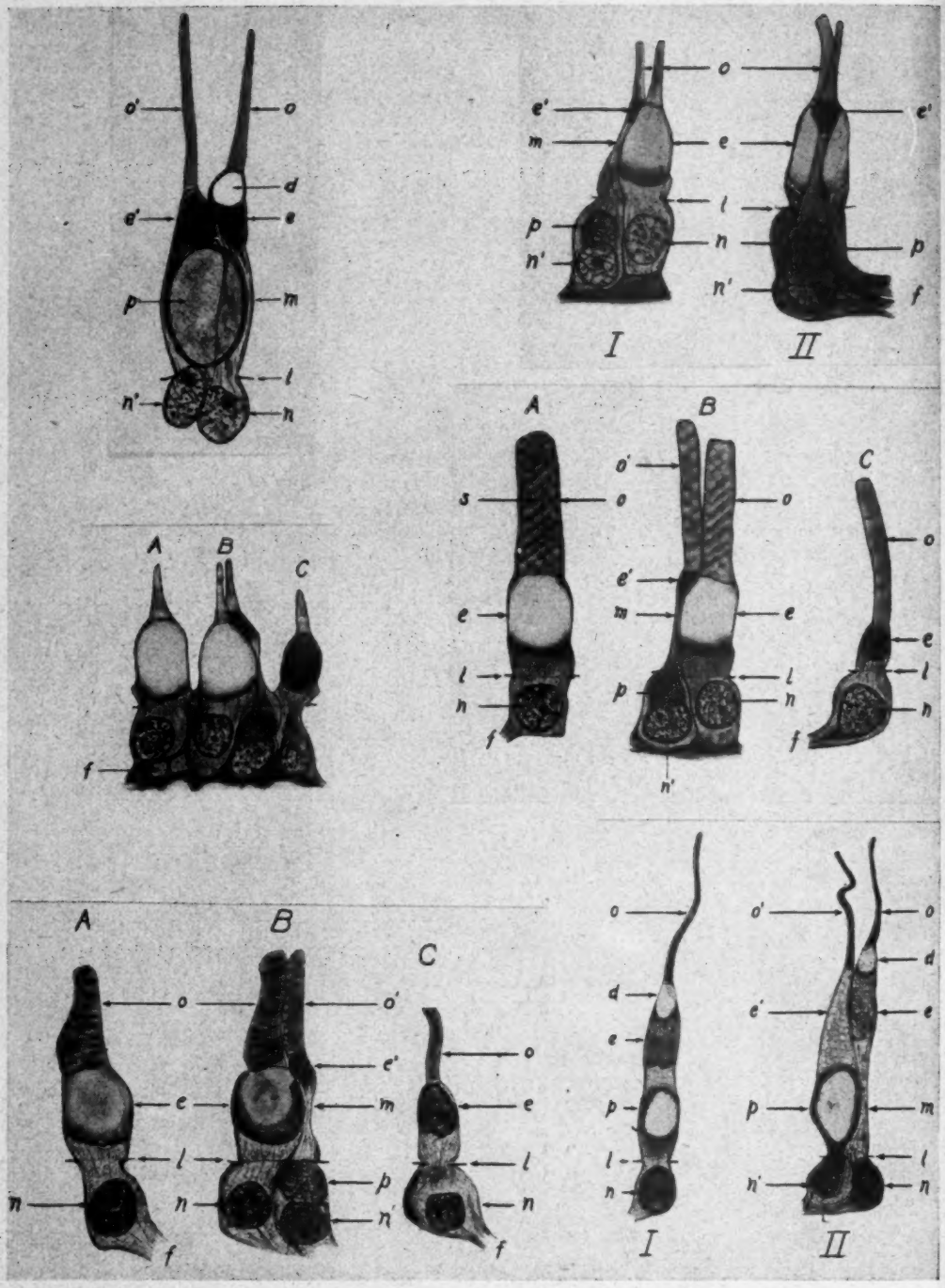

Fig. 1 (Walls). Double cone of Snapping Turtle, *Chelydra serpentina: d*, oil-droplet; *e*, ellipsoid of chief cone; *e'*, ellipsoid of accessory cone; *l*, limitans; *m*, myoid of chief cone; *n*, nucleus of chief cone; *n'*, nucleus of accessory cone; *o*, outer segment of chief cone; *o'*, outer segment of accessory cone; *p*, paraboloid of accessory cone. Kolmer's fluid, Mallory's triple stain; ×1000.

Fig. 2 (Walls). Double cones of Milk Snake, *Lampropeltis t. triangulum: e*, ellipsoid of chief cone; *e'*, ellipsoid of accessory cone; *f*, foot-pieces; *l*, limitans; *m*, myoid of accessory cone; *n*, nucleus of chief cone; *n'*, nucleus of accessory cone; *o*, outer segments; *p*, paranuclear body. The aspects of *I* and *II* are 90° apart. Kolmer, Mallory; ×1000.

Table 1

DEVELOPMENT OF NOCTURNALITY IN SNAKES; THE *Hypsiglena* SERIES

Form	Light habits	Contracted pupil	Lens	Rows of outer nuclei	Rows of inner nuclei	Ganglion layer	Types A, B, & C visual cells, structurally	Rhodopsin
Coluber constrictor flaviventris	Diurnal	Circular	Strongly yellow	1	7	Single, compact	Cones	Absent
Lampropeltis t. triangulum	Secretive, crepuscular	Circular	Pale yellow	1	6	Single, compact	Cones	Absent
Rhinocheilus leconteï	Secretive, crepuscular	Circular	Colorless	1	6	Single, compact	Intermediate	Absent
Arizona elegans	Crepuscular, nocturnal	Egg-shaped, narrow end uppermost	Colorless	1	5	Single, loose	Intermediate	Absent
Trimorphodon vandenburghi	Nocturnal	Vertical slit	Colorless	1	4	Single, loose	Intermediate	Absent?
Phyllorhynchus decurtatus	Nocturnal	Vertical slit	Colorless	1	5	Single, loose	Rods	Absent
Hypsiglena ochrorhynchus	Nocturnal	Vertical slit	Colorless	1	5	Single, compact	Rods	Absent?

an expression of habits, not of kinship, and they represent only a series of conditions through which *Hypsiglena* and *Phyllorhynchus* must once have passed. These conditions may be static, or such forms as *Arizona*[13] may be in the act of evolving the entire *Hypsiglena* complex of adaptations.

Coluber is included in the table as an example of an active, light-loving snake; any one of many other genera could have served. In *Coluber* the pupil is circular or nearly so, the lens is yellow, and the inner nuclear layer is of ordinary thickness—not nearly so thick as in some other bright-light serpents.

[13] It is interesting to note that the diurnal genus *Pituophis* stands very close to *Arizona*, and is probably the genus from which the latter was derived. *Arizona* can thus be thought of as a *Pituophis* which has become generically distinct partly as a result of changes accompanying its tendency toward nocturnality.

Fig. 3 (Walls). Cone types of Indigo Snake, *Drymarchon corais couperi: A*, large single (Type A) cone; *-B*, double (Type B) cone; *-C*, small single (Type C) cone; *f*, foot-pieces of cones in adjacent section, passing perpendicular to plane of section.
Kolmer, Mallory; ×1000.

Fig. 4 (Walls). Rod types of Spotted Night Snake, *Hypsiglena ochrorhynchus: A*, large single (Type A) rod: *e*, ellipsoid; *f*, foot-piece; *l*, limitans; *n*, nucleus; *o*, outer segment; *s*, myeloidin spirals.
B, double (Type B) rod: *e*, ellipsoid of chief rod; *e'*, ellipsoid of accessory rod; *l*, limitans; *m*, myoid of accessory rod; *n*, nucleus of chief rod; *n'*, nucleus of accessory rod; *o*, outer segment of chief rod; *o'*, outer segment of accessory rod; *p*, paranuclear body.
C, small single (Type C) rod: *e*, ellipsoid; *f*, footpiece; *l*, limitans; *n*, nucleus; *o*, outer segment.
Kolmer, Mallory; ×1000.

Fig. 5 (Walls). Visual-cell types of Faded Snake, *Arizona elegans: A*, large single (Type A) element: *e*, ellipsoid; *f*, foot-piece; *l*, limitans; *n*, nucleus; *o*, outer segment.
B, double (Type B) element: *e*, ellipsoid of chief member; *e'*, ellipsoid of accessory member; *l*, limitans; *m*, myoid of accessory member; *n*, nucleus of chief member; *n'*, nucleus of accessory member; *o*, outer segment of chief member; *o'*, outer segment of accessory member; *p*, paranuclear body.
C, small single (Type C) element: *e*, ellipsoid; *f*, foot-piece, *l*, limitans; *n*, nucleus; *o*, outer segment.
Wittmaacks' fluid, Mallory; ×1000.

Fig. 6 (Walls). Cone types of Collared Lizard, *Crotaphytus collaris: I*, single cone: *d*, oil-droplet; *e*, ellipsoid; *l*, limitans; *n*, nucleus; *o*, outer segment; *p*, paraboloid.
II, double cone: *d*, oil-droplet; *e*, ellipsoid of chief cone; *e'*, ellipsoid of accessory cone; *l*, limitans; *m*, myoid of chief cone; *n*, nucleus of chief cone; *n'*, nucleus of accessory cone; *o*, outer segment of chief cone; *o'*, outer segment of accessory cone; *p*, paraboloid of accessory cone.
Kolmer, iron hematoxylin and phloxine; × 1000.

The ganglion layer is single but compact, the nuclei being close together. Rhodopsin is lacking and the outer segments of all cells are small and conical.

Lampropeltis represents a number of secretive snakes which conceal themselves for much of the time and come out to feed in twilight periods. The spotted-color pattern indicates low speed of movement and there is less need for a high visual acuity than for a slightly increased sensitivity to diffuse light. The reduced coloration of the lens indicates that this sensitivity has been obtained, but there has been no need to modify the visual cells themselves. A little extra degree of summation, evinced by the thinner inner nuclear layer, has sufficed; and the consequent slight reduction of visual acuity is tolerated.

In *Rhinocheilus*, which is more strongly restricted to crepuscular activity than is *Lampropeltis*, sensitivity has been increased still further by the enlargement of the outer segments, that of the Type C cell being practically cylindrical. There is no more summation than in the case of *Lampropeltis*, but the lowered threshold of the visual cells has permitted activity in dimmer light. All need for a yellow filter is gone, and the lens has become completely colorless.

Arizona leans further toward the nocturnal side. This form has been taken wandering actively at 10:00 p.m. While the visual cells are no more rodlike than those of *Rhinocheilus*, a considerable increase in summation has rendered the retina so sensitive that a circular pupil is no longer fully protective. The pupil of *Arizona* contracts to a vertical egg shape with the narrow end uppermost[14]. Rhodopsin is definitely absent in both *Rhinocheilus* and *Arizona*.

In *Trimorphodon* the huge eye has a typical slit pupil indicating still greater sensitivity than in *Arizona*. This sensitivity shows itself in the strictly nocturnal habits and in the dazzlement to which the species is subject when in bright light, as evinced by its inaccuracy in striking under those conditions (Klauber, 1928). The outer segments are now very large but not yet cylindrical. The inseparability of the retina and pigment epithelium made it impossible to test for rhodopsin (Walls, 1932c), but it is improbable that the substance is present. A maximum of summation occurs in this form—the inner nuclear layer is the thinnest of any member of the *Hypsiglena* series[15] and the ganglion layer is sparse.

Phyllorhynchus and *Hypsiglena* probably have not much more sensitivity than *Trimorphodon*, their completely cylindricized outer segments being offset by a slightly less degree of summation than occurs in the latter form. The inner nuclear layers of both contain five rows of nuclei; the ganglion layer of *Hypsiglena* is more compact, but this is probably due to the sharp curvature of the retina of this small eye[16].

The reader may be puzzled by the declaration that "summation" is going on in a retina whose inner nuclei at all outnumber the visual-cell nuclei; but it should be remembered that in addition to straightforward bipolar cells the inner nuclear layer contains Müller-fiber, amacrine, horizontal bipolar, horizontal glial and some ganglion nuclei. Ideally, the projective bipolar cells should be identified and counted, and alone compared in numbers with the visual cells, but this is impossible except in silver impregnations. The latter, because of the crude fixations involved, would show the visual cells so poorly that their employment would be unwise where material is so rare and difficult to obtain as in the present case.

[14] The *Arizona* pupil begins to depart from its circular expanded form at an intensity of 15 F.C. and a diameter of .8 mm. By way of comparison, the eye of a *Lampropeltis* species (*L. pyromelana*) is smaller than that of *Arizona*, but the minimal area of the pupil is several times as great.

[15] The amount of summation seen in *Trimorphodon* is not nearly a maximum for *all* snakes. Thus *Leptodira*, a member of the *Tarbophis* series, has the outer nuclear layer actually thicker than the inner.

[16] That is, the areas of the inner and outer surfaces of the retina are so greatly disparate that even contiguous ganglion cells would not be in anything like a 1:1 ratio to the visual cells.

The ratio of rows of nuclei is thus admittedly a crude index of sensitivity; but it is certainly of some value, for it seems never to conflict with other criteria. There is precedent for its use, in the work of Woollard (1927) on primate retinae.

From a consideration of the above series of situations, the course of transmutation as it has occurred in *Hypsiglena et al* may be tentatively pictured as follows:

The abandonment of active, bright-light habits permits, and the adoption of secretive habits requires, a reduction of visual acuity and an increase of sensitivity accomplished by increased summation. The outer segments begin to enlarge and as summation is further increased the enhanced sensitivity demands some change in the pupil. Sufficient sensitivity to require a slit pupil and to permit complete nocturnality may now be attained either by further summation (*Trimorphodon*) or by perfect cylindricization of the outer segments (*Phyllorhynchus* and *Hypsiglena*). It seems to have been unnecessary for any member of the *Hypsiglena* series to produce a rhodopsin[17], but it would be idle to deny them the designation of "pure-rod" on that account.

Trimorphodon, Phyllorhynchus, and *Hypsiglena* are probably equally well adapted for nocturnal activity, but since our attention is focused here upon the visual cells themselves, the latter two genera are arbitrarily considered to be the perfect ophidian examples of pure-rod forms with pure-cone origins.

The Lizards

1. Lacertilian visual-cell patterns. While the adoption of strict diurnality and a pure-cone retina did not occur in the snake group until the Colubridae had been evolved, the ancestors of the lizards appear to have taken this step before the divergence of the Rhynchocephalia and Squamata.

At any rate, all lizards display a simplex pattern containing single and double visual cells. With the sole exception of the geckoes, these visual cells are all provided with oil-droplets and are thus unquestionably cones from the standpoint of ancestry.

We noted in the snakes that the coloration of the lens afforded a rough index of the sensitivity of the retina as a whole. In the lacertilians, on the other hand, the presence of an intracellular (oil-droplet) type of filter makes it possible to determine more surely the relative sensitivities of the visual cells themselves. Thus the presence of only colorless oil-droplets would indicate that the threshold of the individual visual cell had been considerably lowered, while if yellow oil-droplets should be found in a nocturnal form it is apparent that the threshold of the visual cell in such a case may not be extremely low, and that the retina probably owes its sensitivity more to summation.

The condition of the fovea affords an additional criterion of the adaptation of a lacertilian retina for high visual acuity; this criterion is lacking in the snakes. While the reduction or absence of a fovea in a member of an ordinarily foveate group does not constitute a sensitivity-increasing modification (witness the loss of the fovea by domesticated birds) it does indicate that high visual acuity has been surrendered. We shall see that wherever, in nocturnal lizards, the fovea has been lost, the obvious explanation is that the eye is so small that extensive summation (for

[17] One often sees the statement that there is an invisible amount of rhodopsin in cones; this is based upon the work of Hecht (1921) and Hecht and Williams (1922) on foveal dark-adaptation in the human. It would seem that if even a trace of rhodopsin were present in all cones, *Hypsiglena et al* would have magnified that trace to a useful and easily demonstrable amount instead of resorting to other means of increasing sensitivity.

The rhodopsins of various groups have long been known to differ considerably, and independent inventions of the substance have surely occurred; but the *Hypsiglena* forms seem able to dispense with it. Determinations of the brightness thresholds of *Hypsiglena* and of rhodopsin-bearing snakes such as *Tarbophis* would be of much interest.

Another supposed evidence for traces of rhodopsin in cones, the demonstration of dark-adaptation in turtles by Hess (1910), is vitiated by the fact that though Hess, Detwiler, and others have not seen them, there *are* rods in turtles (see figure 11).

sensitivity)and the isolated conduction of macular areas (for acuity) are incompatible. For small eyes, the rule holds that high acuity and high sensitivity are mutually exclusive unless summation plays little or no part in conferring the sensitivity.

Of the score or more families of lizards recognized by modern herpetologists, five have greatly reduced or even functionless eyes. Of the families with well-developed eyes, five are strongly nocturnal, the others strictly diurnal. As with the snakes, the vast majority of species and individuals are light loving.

Most vertebrates, having duplex retinae, can exhibit shades of preference for various illuminations intermediate between the extremes of sunlight and quasi darkness. These conditions have their basis in the infinity of rod-to-cone proportions possible for a duplex retina. The presence of *only* simplex retinae in lacertilians seems to account for the almost total absence of these nuances of adaptation in this group; thus, only a very few lizards, such as *Anguis fragilis*, have been called "crepuscular."

The visual-cell patterns of diurnal lizards are similar and consist of double cones intermingled with a larger number of single cones (fig. 6). The latter vary in size, but with such gradation that no definite number of distinct morphological types can be surely identified. That more than one real type of single cone is present is seen from the study of the fresh retina, where both yellow and colorless oil-droplets are seen. The number of single-cone types that actually exist is, however, immaterial to our present purpose, since there is no need (as there is in snakes) of trying to homologize any one type of single element in a diurnal retina with some one type in a nocturnal form; and the double elements of course make their own comparison, as in the case of the members of the *Hypsiglena* series.

Representatives of three of the five nocturnal families have been investigated to date, *viz.*, the Gekkonidae, Xantusiidae, and Helodermatidae. Of the other two nocturnal groups, one, the family Uroplatidae, is monotypic and its sole genus, the Madagascan *Uroplatus*, is merely a modified gecko. The other, the Pygopodidae, is Australian and its representatives have not yet been obtained.

The pertinent facts relating to lacertilian retinae are given in table 2, in which *Gerrhonotus* represents the diurnal lizards in general and was selected at random as was *Coluber* in the construction of table 1. *Sphenodon* has been placed with the lizards in table 2 purely for convenience, with no implication of close kinship.

2. *Heloderma.* The Helodermatidae, represented here by *Heloderma suspectum* (the Gila Monster) are nocturnal lizards whose eyes present two exceptional features. Their contracted pupils are small and circular whereas those of other nocturnal reptiles are vertical slits; and they have functional lids, while other nocturnal Squamata all have the mobile lids replaced by a spectacle (see Walls, 1934). There may well be a relation between these features, for the retention of lids may in turn have permitted the retention of a circular pupil form.

Heloderma constitutes, if not an exception, then at least a disturbance to the Duplicity Theory; for, although nocturnal, it has no well-developed rods. This apparent paradox is easily explained, but it indicates a need for attention to the properties of the retina as a whole—especially in simplex cases —as well as to the capacities of the visual cells themselves.

The visual cells of *Heloderma* fit the conventional lacertilian plan—single and double elements, all with oil-droplets. The latter are completely colorless and of ordinary size. Rhodopsin is lacking and there is no trace of a fovea. The outer segments are more massive than those of diurnal lizards, but do not approach in volume those of some even more rodlike droplet-bearing cells to be treated later in these pages. The visual cells of *Heloderma* have become sensitive enough to make the depigmentation of the oil-droplets worth while, but not enough to demand a departure from a circular pupil. At the risk of seeming

arbitrary, the writer terms them "intermediate" and would compare *Heloderma* with *Trimorphodon* of the *Hypsiglena* series.

Like *Trimorphodon*, *Heloderma* owes its capacity for nocturnality very largely to the extensive summation performed by the bipolar and ganglion cells. Most of the excess sensitivity of the *Heloderma* retina over that of, say, *Gerrhonotus* is due to this feature. The outer nuclear layer contains 1½ rows, the inner nuclear layer *only 3*, and the ganglion layer is single and most crude, its component cell-bodies far apart. The contrast of *Heloderma* with diurnal lizards, in these regards, is brought out in table 2.

Table 2

DEVELOPMENT OF NOCTURNALITY IN THE LACERTILIANS AND *Sphenodon*

Form	Light-habits	Contracted pupil	Oil-droplets	Rows of outer nuclei	Rows of inner nuclei*	Ganglion layer	Droplet-bearing single and double visual cells, structurally	Rhodopsin	Fovea
Gerrhonotus scincicauda	Diurnal	Circular	Yellow	1½†	13†	Triple, compact†	Cones	Absent	Deep
Heloderma suspectum	Nocturnal	Circular	Colorless	1½	3	Single, very loose	Intermediate	Absent	Absent
Sphenodon punctatum	Fossorial, nocturnal	Vertical slit	Pale yellow	1†	6†	Single, compact†	Rods‡	Absent	Shallow
Xantusia riversiana	Nocturnal	Vertical slit	Colorless	1	8	Single, compact	Rods	Absent	Absent
Coleonyx variegatus	Nocturnal	Vertical slit	Absent	2	16	Double, compact	Rods	Present	Absent

* Including ectopic bipolars.
† Extramacularly.
‡ A very few droplet-free cones present.

Thus *Heloderma*, a sluggish egg-eater, is to be interpreted as a form which has gained the sensitivity needed for scotopic activity largely through summation. There has been no need for a truly profound alteration of the visual cells themselves, for the habits of the animal are such that it tolerates the low acuity which was the inevitable result of its choice of method of scotopic adaptation. *Heloderma* is included here not only as a case of partial transmutation of the visual cells, but also for its value in showing how and why transmutation has been forced upon those simplex forms to which sensitivity *and* acuity are both of prime importance.

3. *Xantusia*. The lizards of the genus *Xantusia* are small, active, and strictly nocturnal; the pupil is a vertical slit throughout the family. Three species have been examined: *X. vigilis*, *X. henshawi*, and *X. riversiana*. The last-named species is confined to a few islands at some distance from the California coast and is rare and difficult to obtain. Its relatively large size makes possible a direct examination for rhodopsin, which is out of the question on the two smaller species. After several years of fruitless inquiry, the writer finally obtained a specimen of adequate size through the great kindness of Mr. J. R. Pemberton.

Heinemann (1877) discovered years ago that the oil-droplets of the Xantusiidae are all colorless; this point has been confirmed for the three species examined. It is clear that here, as in *Heloderma*, the absence of pigment is secondary and indicates a low threshold of stimulation. The visual cells are morphologically identical with the cones of diurnal lizards except for the huge size of the outer segments and oil-droplets (fig. 7; cf. fig. 6).

The retina of *Xantusia* is structurally simplex and, in view of the strict nocturnality of the animal, is physiologically a pure-rod one. Whether or not we should term the visual cells "rods" will, however, depend upon a reconsideration of our definitions. Rhodopsin is lacking in *Xantusia*. If its presence be insisted upon as a part or the whole of

a definition of rod visual cells, then *Xantusia* has a pure-cone retina and constitutes a most conspicuous exception to the Duplicity Theory. *Xantusia* seems to be about as well off in dim light as though it *did* have rhodopsin. The outer segments are huge and the large oil-droplets compensate appreciably, by their light-gathering power, for the absence of a sensitizing pigment. There is no fovea in *Xantusia*, so that there is no area in which conduction is so well isolated as in the foveal region of the diurnal lizard; but the extent of summation is not nearly so great as in *Heloderma* (see table 2), nor indeed much greater than in the extramacular diurnal retina. The active habits of the animal, in contrast to those of *Heloderma*, have forbidden the sacrifice of much acuity.

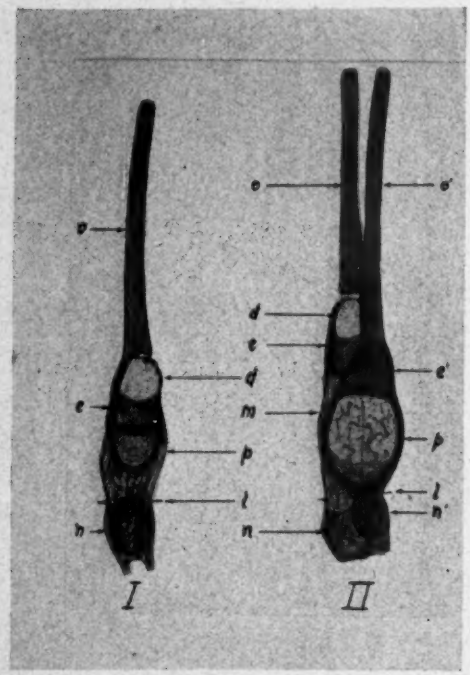

Fig. 7 (Walls). Rod types of Rivers's Night Lizard, *Xantusia riversiana: I*, single rod: *d*, oil-droplet; *e*, ellipsoid; *l*, limitans; *n*, nucleus; *o*, outer segment; *p*, paraboloid.

II, double rod: *d*, oil-droplet; *e*, ellipsoid of chief rod; *e'*, ellipsoid of accessory rod; *l*, limitans; *m*, myoid of chief rod; *n*, nucleus of chief rod; *n'*, nucleus of accessory rod; *o*, outer segment of chief rod; *o'*, outer segment of accessory rod; *p*, paraboloid of accessory rod.

Kolmer, Mallory; ×1000.

Since the visual cells themselves have had to bear most of the burden of scotopic adaptation there should be no quarrel with a designation of them as rods, and the presence of oil-droplets is enough to show that these rods were once cones. *Xantusia* is thus comparable to *Hypsiglena* in its possession of a pure-rod (but rhodopsin-free) retina of pure-cone origin.

Nothing is as yet known of the situation in the Pygopodidae, but it may be confidently expected that these nocturnal, slit-pupiled Australian lizards will prove to have a *Xantusia*-like retina.

4. The geckoes. The term "gecko" as used here is understood to cover the members of the families Uroplatidae, Gekkonidae, and Eublepharidae—the last named an assemblage of primitive genera possessing functional lids which is sometimes regarded as homogeneous and deserving of family rank.

The geckoes are of intense interest from the standpoint of the transmutation theory. There is nothing about their retinae which conflicts with the theory, and there is at least one feature —the double rod—which offers a very great difficulty to the traditional view of visual-cell evolution.

Nearly all geckoes are nocturnal, with slit pupils which are sometimes capable of complete closure[18] and with simplex retinae containing single and double rods. The latter structures have hitherto been considered unique[19], but we have seen that they are imitated by the Type B elements of *Hypsiglena* and *Phyllorhynchus*.

Abundant rhodopsin is present. Oil-droplets are entirely lacking, which might seem evidence against the geckoes' rods ever having been anything else; but the snakes have also had la-

[18] Seemingly to compensate for the absence of movable lids. Unlike other nocturnal reptiles, the geckoes appear to be perfectly comfortable in extremely bright light.

[19] Ramón y Cajal (see Franz, 1913, p. 22) described double rods from neurological preparations of frog retinae, but these were artificial appearances.

certilian ancestry, and their cones have lost the oil-droplets of their ascendants[20].

The double rod of the gecko retina has heretofore rarely, if ever, been correctly seen. Misconceptions as to its structure, some as serious as in the case of the ophidian double cone, have tended to conceal its relation to the typical lacertilian double cone and thus to promote a false idea of its uniqueness. Thus Detwiler (1923a) describes the double rod as having only one nucleus, and Ranvier (1889), while he figures the outer nuclear layer properly, failed to see the myoids of the chief members. The drawing of Rochon-Duvigneaud (1917, fig. 4) is faithful but is unfortunately on a very small scale. While this investigator clearly understood the structure, he did not call attention to Ranvier's error nor make the situation clear enough to prevent Detwiler's mistakes.

The visual cells of *Coleonyx variegatus* (fig. 8) may be taken as representative. In this American "Eublepharid" the rods are more slender than in most geckoes, and the inner segments have more nearly the appearance of the corresponding parts of diurnal lacertilian cones. The essential differences from diurnal cones are: the absence of the oil-droplet; the shape and size of the outer segment; and the presence of rhodopsin. The double rod is *binucleate*, and is more logically seen as a product of transmutation than as the result of the bifurcation of a single rod. The pure-rod retina of the gecko, like that of *Hypsiglena*, represents not a loss of the cones of an ancestral duplex retina but the end product of a transmutation of single and double cones into single and double rods. While *Xantusia* is not a close relative of the geckoes, its retina exhibits a stage through which that of the gecko must once have passed.

Table 2 brings out the contrast between *Xantusia* and *Coleonyx*. In the former, rhodopsin has not been produced and the oil-droplet, while it has naturally been rid of detrimental pigmentation has been retained and even enlarged, the better to perform the dioptric function, which, in a pigmented droplet is decidedly secondary to the filtering action upon the shorter wave

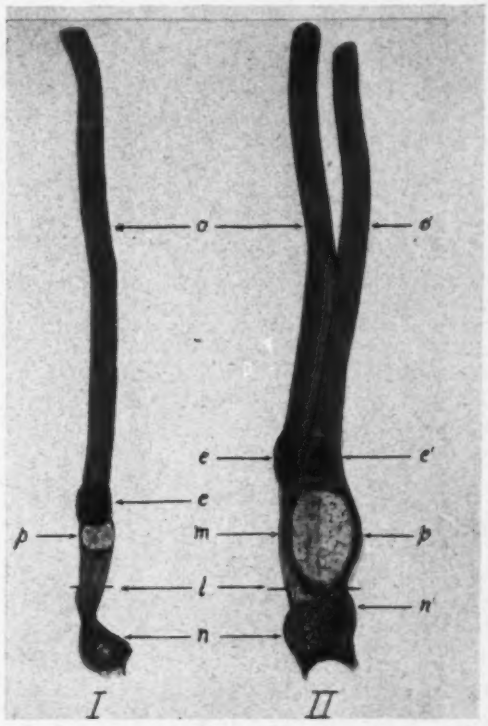

Fig. 8 (Walls). Rod types of Banded Gecko, *Coleonyx variegatus: I*, single rod: *e*, ellipsoid; *l*, limitans; *n*, nucleus; *o*, outer segment; *p*, paraboloid.

II, double rod: *e*, ellipsoid of chief rod; *e'*, ellipsoid of accessory rod; *l*, limitans; *m*, myoid of chief rod; *n*, nucleus of chief rod; *n'*, nucleus of accessory rod; *o*, outer segment of chief rod; *o'*, outer segment of accessory rod; *p*, paraboloid of accessory rod.

Kolmer, Mallory; ×1000.

lengths. The geckoes (an older group) have, on the other hand, been able to produce a rhodopsin and hence dispense with the oil-droplet entirely. Their sensitivity is obtained by the use of rhodopsin and by an increase in the length of the outer segment. Thus acuity is not sacrificed and the animal is able to carry

[20] The writer has elsewhere pointed out that the absence of oil-droplets in snakes is indicative of a long-continued photophobic habit on the part of the earliest serpents (see Walls and Judd, 1933; Walls, 1934).

on its exacting insectivorous activities even in bright light. Geckoes are commonly observed to lurk in shadows and make frequent dashes into glaring sunlight after small insects. There is less summation than in *Xantusia,* the eyes are larger, and the visual cells are more slendor and more closely set. Foveae have been erroneously reported for one or two geckoes, but it would not be at all surprising if some species were found which had actually retained this feature. Certainly only the owl equals the gecko in all-round, twenty-four-hour visual performance.

Rhynchocephalia, have been studied by Osawa (1898, 1899), Kallius (1898), Virchow (1901), Bage (1912), and Mann (1932, 1933). While Osawa was more nearly correct, in his claim that cylindrical outer segments were present, than Virchow and Bage would admit, his work was in general crude and has been so ably criticized by the latter authors that it will be dismissed here.

Virchow considered the *Sphenodon* retina to be practically pure-cone and distinguished single and double cones. He was undecided as to how many kinds of single cones deserved recogni-

Table 3

Form	Estimated proportion of sensitivity owed to:			Estimated perfection of adaptation for nocturnality
	Summation	Enlargement of outer segments and oil-droplets	Rhodopsin	
Gerrhonotus	—	—	—	0
Heloderma	90%	10%	0	50%
Sphenodon	30%	70%	0	75%
Xantusia	25%	75%	0	75%
Coleonyx	0	50% (no o.d.)	50%	100%

It is within the gecko group that a reverse—tertiary—transmutation of rods into cones has very probably occurred. Several genera of geckoes are diurnal, two of them, *Phelsuma* and *Lygodactylus,* conspicuously so. Neither of these round-pupiled, light-loving genera is primitive. What is more probable than that they have relinquished rhodopsin and reduced the outer segments of their immediate nocturnal ancestors, and that some substitute for yellow oil-droplets—possibly a yellow lens, as in snakes—has been produced by them?

A rough estimation of the relative importance of the three chief devices for increasing sensitivity and of the relative perfection of all-round scotopic adaptation evolved by the forms in table 2, is given in table 3. It is not intended that these estimates shall be taken too seriously:

SPHENODON

The visual cells of this important reptile, the sole survivor of the order

tion as distinct types, and deplored the lack of observations on the fresh *Sphenodon* retina. Virchow believed that if the number of different oil-droplet colors were known, it could at once be decided how many actual types of single cones were present.

Without knowledge of Virchow's work, Bage and Mann (studying the same material) confirmed the former in most respects. Bage found only cones, single and double, the latter of two distinct sizes with the larger more abundant.

The single and double elements which Virchow, Bage, and Mann have called cones were so identified by these investigators on the basis of the presence of oil-droplets. It is because they found no cells lacking oil-droplets (excepting, of course, the accessory members of the doubles) that Bage and Mann pronounced the *Sphenodon* retina pure-cone.

It has been mentioned that Virchow considered *Sphenodon* to be *practically* pure-cone; he found a very few cells which he thought might be rods. They

were admitted to this consideration "because of their lack of cone-characteristics, not because of any positively rod-like qualities." Thus, Virchow describes them as small, cylindrical, without oil-droplets or paraboloids, and with the ellipsoid either absent or obscure. The outer segment was always broken or else covered with retinal pigment and the foot-piece was never found in the same section.

This is a perfect description of a normal single *Sphenodon* "cone" (droplet-bearing) which has been sliced longitudinally *but superficially*. Virchow mentions that some entire sections contained none whatever, and if either Bage or Mann noticed any they were not deceived by them. Eliminating these "rods," Virchow's findings come into closer agreement with those of the latter authors.

We can say, then, that, according to the best of the scanty literature, *Sphenodon* possesses only single and double elements, all of which have oil-droplets and are thus ancestrally cones[21]. This is of course the lacertilian pattern, though the eye of *Sphenodon* as a whole is as turtlelike as it is lizardlike—if not more so. As regards the all-important outer segments, Virchow, Bage, and Mann found them to be conical. They fail to emphasize the greater bulk of the *Sphenodon* structure as compared with diurnal lacertilian outer segments, though even the mangled outer segments shown in Miss Bage's faithful drawings are huge.

Other claims of importance in the literature are the following: the fovea is deep and contains only long *rods* (Kallius); it is shallow and contains only *single cones* whose outer segments are no different from those elsewhere (Virchow, Bage). The foot-pieces are slender and stand out clearly without silver-impregnation (Virchow, Bage); some run slantwise for considerable distances in the outer molecular layer (Virchow, Bage); these are associated with the slenderest of the single "cones," whose nuclei are especially deep-lying (Bage).

None of the above authors appears to have been struck by the contradiction of a pure-cone retina in an animal whose pupil is a vertical slit, and which sleeps in a burrow by day and prowls by night.

The writer's material of *Sphenodon* consists of three eyes. Two, obtained several years ago and preserved in Perenyi's and Kolmer's fluids, respectively, were removed in the morning from a specimen of Dr. F. N. Blanchard's which had died sometime in the preceding night. The third eye, which was preserved in Kolmer's fluid, was excised from a freshly-killed specimen by Dr. W. P. Gowland of the Department of Anatomy of the University of Otago, who also rendered invaluable aid by examining the fresh retina of the other eye of this specimen (using the technic of Walls, 1932c) for rhodopsin and, under apochromatic optics, for colored oil-droplets.

The post-mortem material in Kolmer's fluid appears to show the same situation described by Virchow and Bage, the paraboloids being perhaps more definitely crenated. The outer segments are on the whole much like those figured by Bage, and the slender foot-pieces show up with astonishing clarity[22]. The foveal visual elements are so bent down by shrinkage that their outer segments are chopped to pieces and thus appear to be quite short. The shrinkage in the fovea has rendered the latter artificially deep, so that at its center the retina is but 106μ thick, measured from lamina vitrea to internal limitans. The fovea photographed by Kallius (1898) is so distorted as to appear even deeper, while the section shown by Miss Bage is not a central one, as is evidenced by the figure of 204μ given by her for the thickness of the retina in the fovea and by the numerous ganglion cells in the center of

[21] For what it is worth, mention should be made of Kolmer's (1925) failure to produce "Kolmer's droplets," supposedly associated only with rods and believed by Detwiler to represent bleached rhodopsin, in *Sphenodon* or in the pure-cone *Varanus*.

[22] Contrary to Miss Bage, the writer does not find that those which run slantwise are necessarily connected with the slenderest single elements.

the fovea as she has represented it[28].

Before the fresh eye recently prepared by Dr. Gowland had been examined, the writer was convinced that the description of Miss Bage was quite adequate, except, perhaps, for her failure to emphasize and interpret the size of the outer segments. Naturally, the shape and true size of the latter showed no more truthfully in the writer's post-mortem material, though preserved in a superior fixative, than in the sections studied by Bage and Mann. The material which Miss Bage regarded as her best had presumably been freshly killed, but was fixed in acetic-bichromate.

The retina of the writer's freshly preserved eye is superbly fixed. A more complete description of this material will be given in a later paper, but here we are concerned chiefly with the visual cells. The inner segments, and more particularly the outer segments, are more cleanly preserved than in Miss Bage's preparations and the outer segments of the droplet-bearing cells are long, stout, and quite cylindrical (fig. 9). The retina is 178μ thick at the center of the fovea, which is relatively shallow, and the visual cells here are of *both* single and double types, each with an oil-droplet, and measure 60-62μ from limitans to tip. The foveal outer segments are perfect cylinders 43μ long and 1.8μ in diameter—which rather justifies Kallius's description of them as rods. As in the case of the rods of geckoes and the cones of the human fovea, this great elongation is necessary to preserve a high volume in a slenderized outer segment.

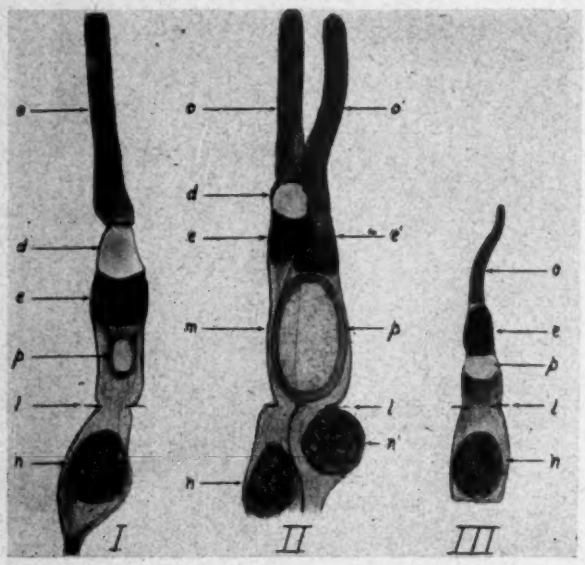

Fig. 9 (Walls). Visual-cell types of Tuatara, *Sphenodon punctatus: I,* single rod: *d,* oil-droplet; *e,* ellipsoid; *l,* limitans; *n,* nucleus; *o,* outer segment; *p,* paraboloid. *II,* double rod: *d,* oil-droplet; *e,* ellipsoid of chief rod; *e',* ellipsoid of accessory rod; *l,* limitans; *m,* myoid of chief rod; *n,* nucleus of chief rod; *n',* nucleus of accesory, rod; *o,* outer segment of chief rod; *o',* outer segment of accessory rod; *p,* paraboloid of accessory rod. *III,* cone: *e,* ellipsoid; *l,* limitans; *n,* nucleus; *o,* outer segment; *p,* paraboloid. Kolmer's fluid. *I* and *II* from Mallory sections, *III* from an iron hematoxylin and phloxine preparation; ×1000.

It is most interesting to note that in this eye the foot-pieces do not show at all. These structures, which the writer has never seen so clearly as in the post-mortem *Sphenodon* retinae, apparently owe their sharp appearance there to post-mortem changes analogous to the well-known post-mortem accentuation of the striation of muscle; and, in Virchow's and Bage's material, to what permits the same changes: the slow action of inferior fixatives.

Apart from the more truthful preservation of the outer segments of the droplet-bearing cells, the most significant difference between the pattern revealed by the writer's fresh specimen and that worked out by Virchow and Bage, *is the presence of an hitherto unnoticed type of cell,* a small single element which lacks an oil-droplet (fig. 9). First seen in the Gowland specimen, these elements were subsequently lo-

[28] Her photograph, according to its scale, gives this dimension as about 190μ. In her text she gives the additional figure of 136μ for the "depth" of the fovea, presumably measured sclerad from a tangent to the macular eminences on either side of the depression.

cated—with difficulty in the inferior post-mortem material.

These cells have slender, pointed, outer segments and are indubitably cones. Equally without question, they can mean nothing to their possessor, for not so many as a score of them can be found in an entire sagittal section through the fovea of this—for a non-crocodilian reptile—huge eye.

It is not implied here that they are functionless, but it is clear that so very sparse a cone-mosaic, acting in its optimum illumination, cannot yield a useful central image nor add significantly to the sharpness of that afforded by the other types of visual cells. Added evidence of the unimportance of these cells is seen in the fact that while they are the least-modified cones in the retina, they are excluded from the fovea, which in other vertebrates is invariably a pure-cone area. The Type C rods of the *Hypsiglena* retina, though relatively as few, are useful because they act with the Types A and B; but the droplet-free cones of *Sphenodon*, acting independently as they must, can be considered nothing but relics of a once important population. Their theoretical significance in this latter connection will be discussed later.

Ignoring these few cones, the remainder of the visual cells compose a *Xantusia*-like pattern: single and double elements of cone ancestry but with massive outer segments. Dr. Gowland found no rhodopsin in *Sphenodon*, and reported that the oil-droplets were "definitely coloured greenish yellow, similar to the yellow globules of the pigeon but . . . larger."

The outer nuclear and ganglion layers are both single and the inner nuclear layer averages six rows extramacularly, so that there is more summation than in *Xantusia*. This, together with the rodlike outer segments and the large oil-droplets (in spite of some pigmentation of the latter) accounts for the nocturnality of *Sphenodon* and necessitates the same interpretation as in *Xantusia*: the droplet-bearing cells of

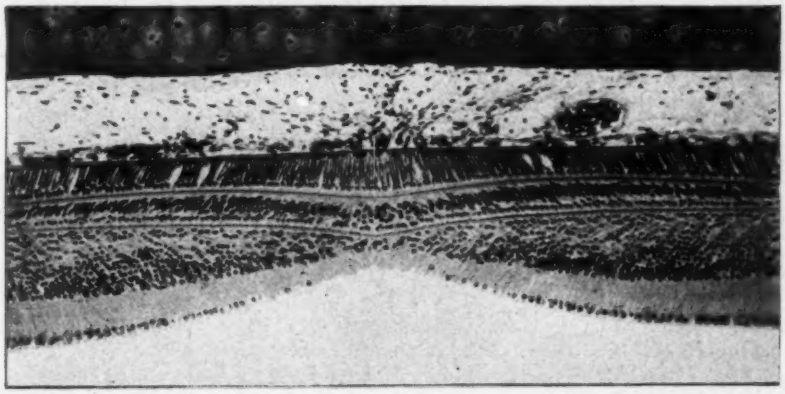

Fig. 10 (Walls). Fovea of Tuatara, *Sphenodon punctatus*, from a bleached, exactly central, horizontal section. Kolmer, iron hematoxylin and phloxine; ×89.

Sphenodon are functional rods whose oil-droplets betray their homology with the cones of diurnal lizards, etc. At the same time the retention of a shallow fovea (fig. 10), a few perfect cones, and some oil-droplet pigment renders the *Sphenodon* retina, on the whole, a perfect (though, of course, nongenetic) intermediate between that of the diurnal lizard and that of *Xantusia*. The latter has completed the degeneration of the fovea and has carried the depigmentation of the oil-droplets to its logical conclusion.

The Turtles and Crocodiles

A consideration of these two groups is included here, not because they offer any proof of transmutation, but rather

to round out this survey and to indicate possible relations of their visual-cell patterns to those of *Sphenodon* and the lizards.

It is well established that most or all crocodilians have duplex retinae (see Laurens and Detwiler, 1921; Rochon-Duvigneaud, 1931). They possess droplet-free single and double cones which are greatly outnumbered by rods of a single type. All crocodilians are noc-

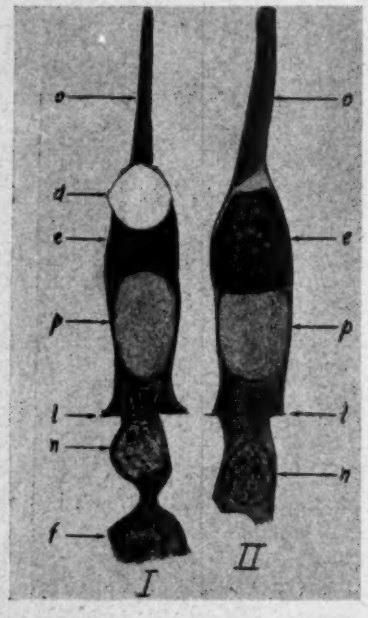

Fig. 11 (Walls). *I*, single cone, and *II*, rod of Snapping Turtle, *Chelydra serpentina*: *d*, oil-droplet; *e*, ellipsoid; *f*, foot-piece; *l*, limitans; *n*, nucleus; *o*, outer segment; *p*, paraboloid. Kolmer, Mallory; ×1000.

turnal, with slit pupils and guanin tapeta.

The turtles are universally held to have only droplet-bearing single and double cones, but adequate technical treatment reveals the presence of rods —many in photophobic forms such as the limicolous *Chelydra* (fig. 11), very few in sun-loving genera such as *Chrysemys*.

The absence of oil-droplets in the crocodiles and their high proportion of rods are comprehensible as factors in the thorough-going nocturnality of the group. These differences aside, it is clear that each visual-cell type in the crocodile has its counterpart in the turtle.

The chelonian rod has a most cone-like inner segment (fig. 11). In tracing the ancestry of the rod of the turtle (and crocodile) we could go no further than this assertion, were it not for the presence of droplet-free cells in *Sphenodon*—the small cones described above. These cells, scanty and isolated in the modern *Sphenodon*, must once have been important in the economy of the ancestral, diurnal Rhynchocephalia. The movement of *Sphenodon* toward nocturnality conscripted the two droplet-bearing cone types because of their fortunate advantage as raw material for scotocyte manufacture. The droplet-free cone has lost all importance and has nearly disappeared.

The rods in light-loving turtles are comparable, in relative numbers, to these droplet-free *Sphenodon* cones. They cannot have much more significance, in the case of such forms as *Chrysemys*. While, as admitted above, the possible homology of the scanty droplet-free elements of *Sphenodon*, the droplet-free elements of turtles, and the more numerous but similar rods of crocodiles cannot be proved or used as support for the general transmutation theory, it is suggested here that the homology does in fact exist.

We may thus conceive the ancestral reptiles as having had three types of cones, one lacking an oil-droplet—the three types perhaps respectively homologous with the three cone-types of the diurnal Amphibia, one of which likewise lacks an oil-droplet and is very scanty. In the lizards the simplest departure from this ancestral pattern has occurred: the droplet-free cone has simply been dropped out. In *Sphenodon* the droplet-bearing cones have been transmuted and the droplet-free cone persists merely as a relic. In the turtles the droplet-bearing cones have remained such in order to support a strong diurnality, and their droplets have become of even greater importance than those of any other subavian group (see Walls and Judd, 1933). The droplet-free cones were favorable for conversion into rods but these have lost all im-

portance in the great sun-loving majority of turtles. In the crocodiles, however, these latter elements have assumed prime importance and the useless droplets of the other two types have been discarded. The crocodiles and *Sphenodon* thus represent different and independent attainments of the same end—nocturnality—from a common beginning; the former present the more perfect scotopic adaptation in their production of a rhodopsin, while *Sphenodon* retains vestiges of its former diurnal condition in its shallow fovea, pale-yellow oil-droplets, and remnant of a photocyte mosaic.

Discussion[24]

In the foregoing pages evidence has been set forth which leads inevitably to the conclusion that many groups of reptiles have become nocturnal secondarily. This has nearly always been accomplished by a transmutation of some or all of the cones of an ancestral, diurnal, pure-cone retina into functional rods; but in at least one case *(Heloderma)* only one of the three major differences between cones and rods (a great degree of summation) has been brought about and has alone been sufficient to lower markedly the threshold of the retina as a whole and thus permit nocturnal activity.

These conversions have taken place independently in the Rhynchocephalia, the Xantusiidae, the geckoes, in all of the large families of snakes excepting the Boidae, and very likely within still other reptilian groups. It should be clear why transmutation has occurred so widely in the lizards and their derivatives, the snakes. The Squamata and Rhynchocephalia have had common ancestry in forms which early adopted the habit of strict diurnality and its histological foundation, the pure-cone retina. The central family of snakes, the Colubridae, likewise attained the pure-cone condition, abandoning the duplex pattern of unknown origin which satisfied the Boidae.

Thus the adaptation of a formerly pure-cone strain to a present photophobic mode of life was rendered especially difficult. Manipulation of the rod-to-cone ratio—the method available to and used by other nonterminal vertebrate groups—was barred, and resort to transmutation was necessary. Where members of these orders have become nocturnal they have perforce changed cones into rods, and transmutation is widespread in reptiles because the sole potential requisitive of the process, the simplex retina, is itself widespread in this class of vertebrates. Where, as in the nocturnal geckoes, the transmutation has involved all of the visual cells, only a second transmutation could make possible a return to diurnality (*Phelsuma*).

So few unquestionably simplex retinae are known outside of the Reptilia that there is no *a priori* reason to suspect any nonreptilian duplex retina of containing secondary rods or secondary cones. The loss-of-one-type explanation probably holds for such simplex forms as the bat, the prairie dog, and the deep-sea fish.

The occurrence of transmutation does not weaken the Duplicity Theory as a statement of *physiological* facts, ex-

[24] It will have been noticed that throughout this paper there has been little mention of the photomechanical changes, which, because of the opposite directions of migration of mobile rods and cones, have been used to distinguish between the two types in doubtful cases (see Laurens and Detwiler, 1921).

Such slight and slow movements occur in lizards and turtles (Detwiler, 1916, 1923b) that they cannot possibly be of value to the animal. When it takes 12 hours or more for a lizard to become "dark-adapted," one cannot consider the slight elongation of the cones to be meaningful. When the writer's mass of light- and dark-adapted lacertilian and chelonian material has been examined, it may well be found that in those cases where cones have become rods, the direction of their migration has reversed. But if such be found not the case, it should not surprise. Vestiges of a conelike migration in the visual cells of *Xantusia*, for example, would hardly overturn the weight of evidence for their scotopic function.

As already noted, the writer has been unable to detect photomechanical changes in the visual cells of any type of ophidian retina, though his material, usually in duplicate, was routinely exposed for 6 hours to light or for 24 hours to darkness. .

cepting the Theory's allocation of hue perception exclusively to cones. Researches on the color vision of such forms as *Xantusia, Coleonyx, Phelsuma,* and *Hypsiglena* will be crucial. We cannot for long allow the Duplicity Theory to carry, without test, the implication that a cone which becomes a scotocyte necessarily loses any hue-discriminatory capacity it may previously have had.

When its more fundamental "threshold" statement is considered, however, the Theory loses all truth unless physiological terms be substituted for the morphological "rod" and "cone"; and with these substitutions, the Theory loses all force.

No organon in all physiology is on a firmer foundation than is the Duplicity Theory, in its true character as a description of the functional antithesis of two physiological types of cells; but as a guide to the interpretation of habits in terms of "structure" the Duplicity Theory, faced with transmutation, has come to the end of its usefulness.

The writer is especially indebted to Dr. John F. Shepard, who supervised this investigation, and to Mrs. Helen T. Gaige for much valuable advice upon herpetological matters. He is very grateful to Drs. W. P. Gowland, F. N. Blanchard, and H. K. Gloyd, and to Messrs. L. M. Klauber, Werner Schröder, and J. R. Pemberton, who supplied the rare and valuable material with which the present paper deals. Facilities and support were furnished by the Museum of Zoology and the Department of Anatomy of the University of Michigan, and by the National Research Council through the medium of a Fellowship in the Biological Sciences.

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STUDIES ON VASCULARIZATION OF THE CORNEA

V. Histological changes accompanying corneal hypersensitiveness

L. A. JULIANELLE, PH.D. AND HARVEY D. LAMB, M.D.
SAINT LOUIS

The principal changes in the cornea consist of, at first, a diffuse or focal proliferation of the corneal corpuscles—the fixed cells of the cornea—or a primary destruction or necrosis of the cornea propria in foci. Secondarily, capillaries enter the cornea as branches of the adjoining conjunctival vessels and run their course between the lamellae of the cornea propria. While the capillaries are usually superficial, they may also be deep, depending upon the severity of the reaction. In a few animals the reaction extends into the anterior chamber and iris, inducing hypopyon in the former and a migration of small lymphocytes and plasma cells into the stroma of the latter. From the Oscar Johnson Institute, Washington University School of Medicine. Conducted under a grant from the Commonwealth Fund of New York City.

When certain bacteria are instilled repeatedly into the conjunctival sac of rabbits[1] or monkeys[2], following gentle scarification of the cornea, a hypersensitive reaction is stimulated, which is characterized by corneal cloudiness and vascularization. That the vascularity thus induced is not primarily due to infection, is demonstrated by experiments[3] in which it is shown that repeated intracorneal injections of filtered, sterile, crystalline egg albumin or bacterial nucleoproteins evoke corneal reactions, clinically indistinguishable from those following instillations of bacteria.

Irrespective of the antigen employed, there is, in general, no visible reaction of the cornea following the first three or four inoculations. From the third to the fifth inoculations, the gross corneal changes of cloudiness and vascularization are initiated. The vascularization always succeeds the cloudiness and begins in the form of delicate capillaries springing from the injected conjunctival vessels. With repeated inoculations, the corneal vessels form small loops, which occasionally show anastomoses, and later descend over the cornea, not as loops, but as a curtain of single vessels which terminate near the middle of the cornea in crow-foot or arborescent processes. Eventually, vessels appear from all directions, reaching centripetally from the entire circumference of the cornea. By continuing inoculations, clouding and vascularization may be maintained indefinitely. In its earlier stages, the reaction resembles pannus tenuis of human trachoma, while the later changes are not unlike pannus crassus[1].

More recently, a study has been made of the histological changes accompanying the corneal reaction of hypersensitiveness, and certain comparisons and contrasts have been made with the changes that occur during the formation of pannus in human trachoma. A report of these observations is included in the present communication.

Experimental

In eliciting the corneal reaction of hypersensitiveness, animals were first made sensitive either by repeated intracutaneous injections of the specific antigen or by direct inoculation of the cornea.[1] In the latter instance, bacteria were inoculated by scarification of the cornea (a single, light scratch with cataract knife, reaching from beneath the superior sclerocorneal margin to the pupil) and instillation of two drops of culture into the conjunctival sac. With protein antigens[3], this method was also used, but preference was given to direct intracorneal injection. When hypersensitiveness was attained by intracutaneous inoculation, the corneal reaction was induced by intracorneal injection of homologous bacterial or native protein or by instillation of homologous bacteria after scarification of the cornea. The bacterial antigens studied were Staph. aureus, Pneumococcus, and Bact. granulosis, while the proteins were crystalline egg albumin and the nucleoproteins of Staph. aureus and Bact. granulosis. Since no distinc-

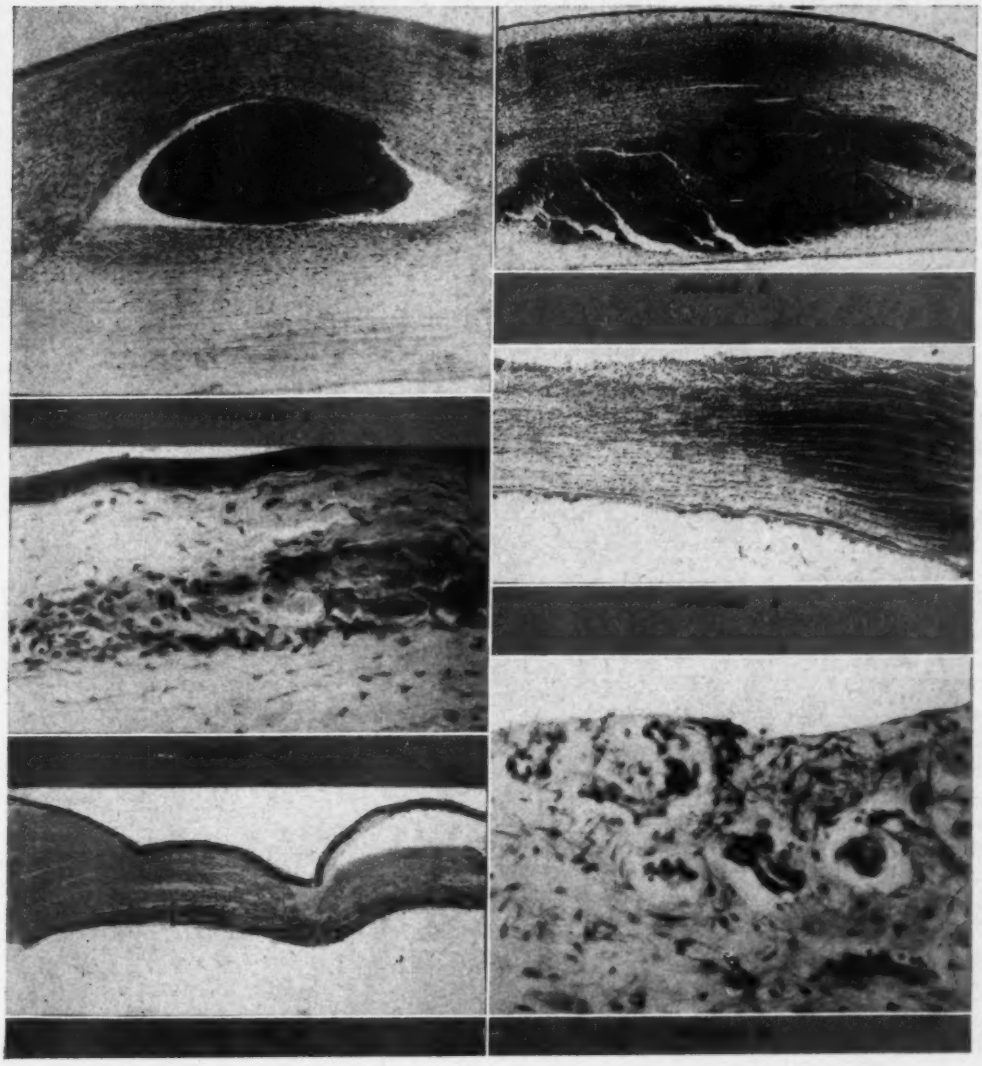

Fig. 1 (Julianelle and Lamb). Section through rabbit's cornea, showing small focus of destroyed cornea propria, largely filled with dense numbers of macrophages and enclosed by a lining composed of proliferated corneal corpuscles. Bordering the focus, anteriorly and laterally, there is a zone of proliferated corneal corpuscles and infiltration with pus cells.

Fig. 2. Section through rabbit's cornea showing massive focus of completely destroyed cornea propria, posteriorly, and partially destroyed cornea propria, anteriorly, with intensive proliferation of corneal corpuscles and dense numbers of macrophages.

Fig. 3. Section through anterior part of rabbit's cornea, showing part of linear focus with partially destroyed cornea propria, a moderate degree of proliferation of corneal corpuscles, and a small number of macrophages.

Fig. 4. Section through rabbit's cornea showing, to the right, part of a massive focus with partially destroyed cornea propria and dense proliferation of corneal corpuscles. To the left, the anterior corneal lamellae are destroyed and pus cells largely occupy the destroyed part and infiltrate the posteriorly adjacent corneal lamellae. A small number of pus cells appear in the anterior chamber.

Fig. 5. Section through monkey's cornea, showing considerable thinning due to primary destruction of anterior corneal lamellae and replacement of anterior epithelium. The retained cornea propria shows, posteriorly, moderate intensity of proliferation of corneal corpuscles and, anteriorly, considerable edema.

Fig. 6. Section through anterior part of iris of rabbit's eye, showing proliferation of endothelial lining of capillaries and the formation of endothelial macrophages.

tion* in corneal changes referable to a respective antigen was observable, the reaction of the tissues will be described as a general reactivity of the cornea to hypersensitiveness rather than as a particular reaction to a special antigen.

The whole eyeball was removed at different stages of corneal activity. It was then fixed in formalin, imbedded in paraffin, and sections from it were stained with hematoxylin and eosin.

Opacity and cloudiness of the cornea are usually the first observable sign of reactivity. This has been accounted for to a great extent as due to a proliferation of the corneal cells or corpuscles. This increase varies greatly in intensity and is either diffuse or focal in character, both types being encountered frequently in the same cornea. Proliferation of the corneal corpuscles is generally most pronounced in the anterior third of the corneal thickness, but when diffuse in character, it usually involves in a gradually diminishing degree, posteriorly, the middle third or more of the cornea. The center and upper half of the cornea participate more frequently in this change. The nuclei of newformed corneal corpuscles often assume bizarre shapes; when cut crosswise, the nuclei may resemble greatly those of polymorphonuclear leucocytes. In foci, where proliferation of the corneal corpuscles is more intensive, groups of large mononuclear cells are also observed. The foci of proliferated corneal corpuscles and the large mononuclear cells form in many instances compact and dense collections of cells. The groups of cells vary in shape from round to linear, and in size from small collections in the superficial and midlying layers of the cornea to broad masses involving all but the most anterior and posterior layers of the cornea propria. Where the large mononuclear cells are massed in large numbers, the lamellae of the cornea propria entirely disappear. Occasionally, corneal lamellae appear to be disintegrating and partially necrotic, along the borders of the larger foci where many proliferated corneal corpuscles intermingle with fewer numbers of large mononuclear cells. Certain groups of large mononuclear cells are surrounded entirely or in part by a closed lining composed of one to several layers of proliferated corneal corpuscles compactly arranged. In and immediately surrounding the collections of large mononuclear cells and proliferated corneal corpuscles, there are generally present many nuclear fragments. In an occasional cornea, there are extensive areas where approximately the anterior half of the corneal thickness may be necrotic, and to a great extent may disappear, leaving a large open wound with the retained corneal tissue very little altered over its base and sides. In several other corneae, small foci of partially necrotic corneal lamellae with little proliferation of corneal corpuscles or infiltration with pus cells may also be observed in the anterior and midlying portions of the cornea. It is not clear whether the foci of entirely absent and partially disintegrated cornea propria associated with dense numbers of proliferated corneal corpuscles and large mononuclear cells are due to a primary necrosis, or whether the foci arise from atrophy of the corneal lamellae.

In only a few corneae, was beginning healing or reparation seen to fill in the empty spaces left by the focal destruction of the cornea propria. This process is usually accomplished by the change of the proliferated corneal corpuscles into fibroblasts and the production of connective tissue.

In some of the corneae, the reaction is marked by the presence of small lymphocytes or round cells and plasma cells. Such infiltration is either focal, around capillaries lying superficially, or diffuse throughout the anterior half of the cornea. This infiltration, especially when encountered in certain instances with a hyperplasia of the endothelial lining of the capillaries, is considered as evidence of chronic inflammation.

The capillaries of the cornea comprise the most striking clinical change.

* In a preceding study it was observed that the cornea of rabbits[1] and monkeys[2] did not show gross changes of cloudiness and vascularization following repeated inoculations of Bact. granulosis. In the present study, however, the evidence indicates that microscopically the cornea actually reacts in the usual way to this organism also.

Moreover, since they increase and decrease grossly both in number and size, they act as a clinical measure of activity of the corneal process of hypersensitiveness. However, the formation of capillaries in the reacting corneae is a secondary change. Histologically, these vessels are constantly observed as branches of the adjoining conjunctival vessels and run their course between the lamellae of the cornea propria. Many of the corneal capillaries are readily visible clinically by the unaided eye, appearing as vessels of comparatively great breadth but of microscopic thinness, since they are flattened out between the adjacent corneal lamellae. In section, however, the capillaries are greatly contracted. During the early stages of development or in milder reactions, the vessels appear as small capillaries lying superficially. Since rabbits do not possess Bowman's membrane or an anterior limiting layer of the cornea, the capillaries are located behind the most anterior lamellae of the cornea propria. In the more intensely reactive corneae, it is not uncommon to observe, in addition to superficial capillaries, deeper ones which are more numerous in the periphery of the cornea. The capillaries are generally most numerous in the superior third of the cornea. With increasing intensity of the corneal process, the blood vessels extend from the neighboring conjunctiva at a correspondingly greater expanse of the corneoscleral junction. The capillaries in the cornea show little anastomosis microscopically. The diameters of the capillaries are naturally largest in the periphery of the cornea and gradually narrow toward the corneal center. The number of capillaries in a cornea exhibiting a reaction varies in general with the reactivity of the cornea, which includes the intensity of the process as well as the volume of the cornea involved.

In some of the animals, the corneal reaction extends to the anterior chamber and iris. In these instances there is evidence of hypopyon in the anterior chamber and a diffuse migration of small lymphocytes and plasma cells into the stroma of the iris. There were found occasionally proliferation of the endothelial lining of the capillaries of the iris, and mononuclear cells which, in some cases, migrated to the anterior chamber.

In addition to the reactions in the rabbits described above, the reaction in the corneae and the irides of the monkeys was characterized by several features: The majority of the monkeys' eyes showing reactions presented a considerable thickening of the corneae, due to a diffuse edema; this was never found in the rabbits' corneae. The edematous condition of the superficial corneal lamellae had led in some places to their partial destruction, and a resultant irregular thickening of the anterior corneal epithelium, and the formation of papillae.

A diffuse infiltration of the monkeys' corneae with pus cells was never present, although in several instances focal collections of pus cells were observed in the anterior and midlying layers.

The hyperplasia of the endothelial lining of the capillaries and the formation of endothelial leucocytes in the iris were more pronounced in the monkeys' eyes.

In order to show the frequency of the aforementioned changes in the corneal reaction of hypersensitiveness, the reactions of the different animals are given in table 1.

While it is obvious that no evidence has been adduced to show that the corneal reaction of hypersensitiveness is related in genesis to the corneal reaction of trachomatous pannus in man, nevertheless both conditions exhibit certain characteristics in common. Therefore the comparisons and contrasts between the two reactions are described, to point out the essential analogies until further studies are undertaken to reveal a possible genetic relationship.

The vascularization of the cornea in hypersensitive animals is similar to that of trachomatous pannus. In both conditions the vascularity consists mainly of superficially lying capillaries, beginning just behind the most anterior lamellae of the cornea propria in rab-

Table 1

SUMMARY OF HISTOLOGICAL CHANGES IN THE EYE ACCOMPANYING VASCULAR REACTION OF THE CORNEA IN HYPERSENSITIVENESS

	Response of Rabbits to				Response of monkeys to
	Staph.	B. gran.	Pneu.	Egg albumin	Egg albumin
I. *Reaction of cornea*—					
(a) superficial capillaries only.	2	2	3	3	1
(b) with diffuse proliferation of corneal corpuscles.	5	1	6	13	6
(c) with diffuse proliferation of corneal corpuscles and infiltration of pus cells.	13	5	3	4	—
(d) with foci of proliferated corneal corpuscles, superficial and midlying.	5	—	4	4	5
(e) with (c) and with focal destruction of corneal lamellae.	1	4	3	3	6
(f) with foci of newly formed cicatricial tissue.	1	—	—	1	3
(g) with diffuse and focal infiltration of small lymphocytes and plasma cells.	2	1	3	3	2
(h) with diffuse thickening due to edema.	—	—	—	—	5
(i) with hyperplasia of endothelial lining of capillaries.	—	1	2	1	—
II. *Reaction of tissues in addition to cornea.*					
(a) infiltration of iris with small lymphocytes and plasma cells.	1	—	—	2	—
(b) hyperplasia of endothelial lining of iris vessels.	—	—	—	1	2
(c) with pus cells in anterior chamber (hypopyon).	1	—	—	2	1
(d) endothelial leucocytes derived from iris capillaries in anterior chamber.	—	—	—	1	2

Total number of eyes studied: in rabbits, Staph. 25; Bact. granulosis, 11; Pneumococcus, 14; albumin, 22; in monkeys, albumin, 11. — indicates reaction not observed; figures represent number of eyes in which tissue changes occurred.

All animals showed clouding and vascularization, and the reactions indicated in the protocol were formed in varying degrees of intensity. As is obvious from the figures, one eye may undergo several different changes.

bits, or Bowman's membrane in monkeys and man.

In both reactions, corneal opacity precedes vascularization and, to a great extent, depends upon proliferation of the corneal corpuscles or fixed cells of the cornea and to an infiltration of large mononuclear cells, small lymphocytes, plasma cells, and to a less degree, of pus cells. In both conditions, the cellular changes are more prominent between the anterior corneal lamellae but where the reaction is of great intensity, the cellular changes and the vascularization may extend in some degree to practically all depths of the cornea; this

is often the case in pannus crassus in trachoma. In the corneal reaction of hypersensitiveness, the proliferated corneal corpuscles and the large mononuclear cells are generally more common than the small lymphocytes and plasma cells, whereas in the corneae with trachomatous pannus the opposite is true. The focal primary destruction of corneal lamellae, which is apparently associated frequently with the reaction of hypersensitiveness, has not been described in trachomatous pannus. In the latter, however, the corneal lamellae are focally destroyed when round-cell infiltration is dense, and great variations in the density of the cellular infiltration for the same cornea is the usual condition in the pannus of trachoma.

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FISTULA AT LIMBUS (SCLEROMALACIA PERFORANS)

Report of a case

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An annoying subconjunctival bleb, of more than one year's duration, near the limbus, came under observation of the author in March, 1932. Several diagnoses were suggested by colleagues and no pertinent etiologic factor was discovered. An operation, intended primarily for biopsy, disclosed a small opening near the limbus from which exuded aqueous humor. The patient had had rheumatic arthritis since childhood. No parallel cases were found in the literature except some of those reported by Van der Hoeve which he called scleromalacia perforans. Read before the St. Louis Ophthalmic Society, January, 1934.

On March 26, 1922, Mr. F. F., aged 65 years, a tailor of duck cloth, consulted me because of inflammation of the eyes, particularly of the left eye. About two years previously he felt a sensation as of a foreign body in the left eye, which caused him to consult his family doctor. In turn, he was referred to an ophthalmologist, who with the assistance of his associate, treated him until March, 1932. Little relief was obtained during this period. Lashes had been repeatedly epillated from the left lower lid, and two months and six months previously operations had been performed for the relief of entropion of the same lid. About January, 1931, the attending eye physician informed the patient of a white area in the region of the upper nasal limbus of the left eyeball, a previous knowledge of which the patient denied. Plus 3.50 D. spherical lenses had been prescribed for near work. The patient had had no former ocular disease or injury which might necessitate the services of a physician.

External examination of the right eye revealed a mild argyrosis and chronic catarrhal conjunctivitis with a small amount of mucoid secretion. The optic-nerve head appeared slightly pale. The left eye seemed to be considerably more irritated than the right, with increased conjunctival injection and lacrimation. This evidently was the cause of a mild bilateral blepharospasm. About 2 mm. below the skin margin of the left lower lid and parallel with it; could be seen a linear scar on its external surface, the result of operations for relief of entropion. Trichiasis was present, especially in the middle third of the lid, and the entire lid rolled in, particularly when the lids were slightly squeezed and when the gaze was bent downward —spastic entropion. The conjunctiva of

the lids and fornix was discolored by argyosis, and the inferior bulbar conjunctiva was injected up to the inferior limbus. A superficial erosion of the inferior bulbar conjunctiva and lower third of the cornea could be demonstrated by staining with fluorescein. At the upper nasal limbus a white cystlike area, extending about 6 mm. along the limbus and about 4 to 5 mm. wide, encroaching over the edge of the cornea about 1½ to 2 mm., was noted. The overlying tissue was free from blood vessels and no signs of irritation could be seen. No other abnormality of the cornea was observed. External examination of the eye was otherwise negative, nor could any pathology be found ophthalmoscopically aside from a slight pallor of the optic disc.

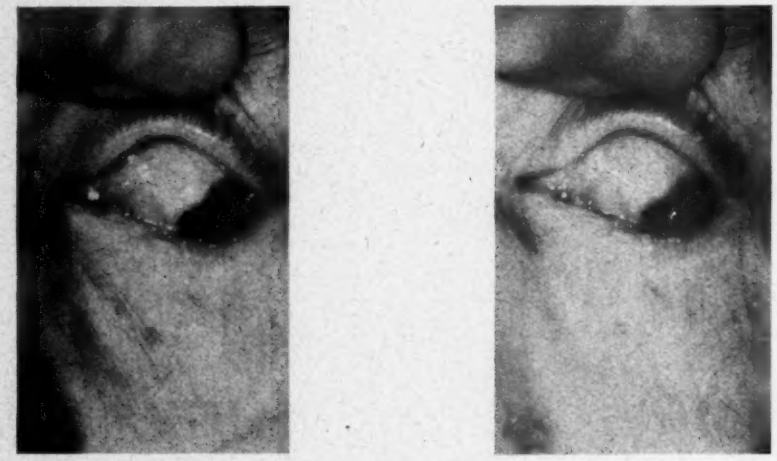

Fig. 1 (Eber). Stereoscopic view showing bleb at present time.

Vision with the right eye was 17/100 and with the left 17/60. With his correction for near work the patient read Jaeger 1 at 18 inches with the right eye and Jaeger 2 at 18 inches with the left. Vision with the right eye with +1.75 D. sph. ⊂⊃ +0.50 D. cyl. axis 180° was 17/13 and Jaeger 1 at 10 inches with +3 D. added. Vision with the left eye with +3.00 D. sph. ⊂⊃ +0.50 D. cyl. axis 45°, was 17/13 and Jaeger 1 at 10 inches with +3 D. added. His muscle balance was normal. Bifocals were prescribed. The intraocular tension of the right eye was 34 and of the left eye 32 mm. of mercury (McLean). The form fields of both eyes were about normal in size.

Six of the offending inverted lashes in the middle third of the left lower lid were removed by electrolysis, and about a month later another offending lash was treated in like manner. Conservative treatment of the lids was continued until about the middle of May, when the patient still complained of the sensation of a foreign body in the left eye when looking downward and was "anxious to have something done." The cystlike area had increased in length and was slightly more elevated, pitting on pressure. Four confrères had examined the patient about this time, one of whom made a diagnosis of possible cystic degeneration of the cornea, while another designated the condition as lymphangioma of epithelial origin.

On May 28, the patient was admitted to a hospital where general and laboratory examinations revealed nothing of relevant interest, except old arthritic changes in the joints of the hands, wrists, elbows, knees, and shoulders. The patient stated that he had had rheumatism since he was 10 years of age. Under local anesthesia the involved bulbar tissue was excised including that which extended over the cornea. The exposed sclero-corneal surface remained moist in spite of repeated spong-

ing. Upon closer observation a small dark spot was seen just behind the limbus at about "10 o'clock," from which continually exuded a clear liquid (evidently aqueous humor); its flow could be increased by pressure on the anterior segment of the eyeball. The lumen of the opening was of small size, and could probably admit a strand of kangaroo tendon. No signs of irritation or inflammation were present. A large conjunctival flap was drawn over the denuded area and held with sutures. To relieve the entropion Jennings's operation was performed.

About the middle of June a persistence of the conjunctival bleb was evident, and it has remained practically unchanged up to the present time. Vision with the right eye with glasses was 17/16 and Jaeger 1 at 11 inches; with the left eye 17/50 minus 2, Jaeger 1 at 7 inches. Refraction of the left eye revealed a decrease of about half of the previous hyperopic error, and with proper correction 17/13 vision for distance and Jaeger 1 at 10 inches with the necessary addition for near vision was obtained. The intraocular tension of the right eye was 40 while that of the left was 24 mm. of mercury (McLean). Two months later the tension of the right eye was 33, that of the left 23 mm. of mercury (McLean), and vision was normal with glasses. No mydriatics or miotics had been employed at any time.

On February 17, 1934, vision with glasses with each eye was still normal and the intraocular tension of the right eye was 34 and that of the left 26 (McLean). The appearance of the eye has remained constant both externally and ophthalmoscopically.

The tissue excised from the left eyeball was examined by the general pathologist of the hospital who reported the following microscopic findings: "conjunctival epithelium is thickened probably to twice the normal depth; connective tissue is also somewhat thickened. There is no indication of a neoplasm."

The specimen was also examined in the Laboratory of Ophthalmic Pathology at Washington University from which came the following report: "the thin flat piece of tissue was covered by a squamous-celled epithelium and contained a thick layer of rather dense connective tissue with areas of dense numbers of elastic-tissue fibers; many small capillaries were present in the connective tissue. Diagnosis: Pinguecular tissue in pterygial growth."

Roentgen examination of the left eye failed to reveal any evidence of intraocular foreign body.

The cause of the fistula is undetermined and I was unable to find a parallel case in the literature until after the preparation of this case report when my attention was called to an article by Van der Hoeve entitled "Scleromalacia perforans"*. Four cases were reported, two of which were his. In his description of case 4, he states: "In the right eye the whole lesion looked like a filtering scar after a Lagrange operation at an unusual location; in fact it was the prototype of a filtering scar," not unlike the case here reported.

In his concluding remarks Van der Hoeve states "there can be distinguished a typical disease of the sclera which consists in the appearance of various-sized holes in the sclera without dominant signs of inflammation, often accompanied by rheumatic polyarthritis, and for which an appropriate name seems to be scleromalacia perforans."

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* Arch. of Ophth., 1934, January, v. 11, no. 1, p. 111.

TECHNIC OF ELECTROCOAGULATION IN THE TREATMENT OF RETINAL DETACHMENT

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The author reports his own technic in the treatment of retinal detachment. He recommends the Walker unit and needles. From the Department of Ophthalmology in the Graduate School of the University of Pennsylvania. Read before the Ophthalmological Club of Washington, D.C., March 1, 1934.

After years of uncertainty and failure in the surgical treatment of retinal separation, those who have followed the gradual evolution of surgical measures proposed during the last few years are beginning to believe that in electrocoagulation a method is offered which bids fair to yield real results.

One recalls a similar state of affairs in the management of glaucoma before and after the advent of some of our modern filtration methods of combating the inevitable blindness that marked the end of many cases of this disease. In fact, in retinal detachment, methods have evolved so rapidly that it has been difficult to follow each proposal with sufficient care to evaluate its merits properly. It is interesting to note, however, that most of our recent satisfactory methods are based on the same basic principle; namely, the sealing up of visible or invisible tears, which Gonin has stressed. It is probable that the recognition of this basic principle has enabled us to move so rapidly toward a satisfactory technic.

In a brief paper presented before the College of Physicians in Philadelphia, in November, I emphasized the fact that if each of the methods proposed by Gonin, Lindner-Guist, and others was followed with meticulous care, as laid down by those who proposed the technic, results in each instance would probably be better than one would surmise from the literature. In other words, the methods of Gonin, Lindner-Guist, and electrocoagulation should be practiced with accuracy and precision if one hopes to obtain a maximum of good results. It so happens that the Gonin technic requires a high degree of accuracy and care in order that the greatest possible number of cures may be obtained. Because the operation in itself is easy to execute (if one ignores the difficulty entailed in accurate localization of the tear), it has been practiced by many ophthalmologists without the accompanying obligation of accurate localization. Because of this last omission, failures have been many in the aggregate. The fault, however, lies not in the operation *per se*, but in faulty technic and lack of experience in localization. There are objections to the Gonin operation which do not apply to electrocoagulation, and one of the chief of these lies in the difficulty of localizing and one's ability to seal the tears securely.

In the method practiced by Lindner and Guist, the need for accuracy of localization is somewhat lessened, but the delicacy of the technic required renders it too difficult for the average operator. In my own cases, good results were obtained in larger numbers with this method than by the Gonin method, because of the greater ease of placing points of coagulation in the trephine openings so as surely to include tears.

Technic

The technic proposed for discussion, namely, micropuncture or electrocoagulation, eliminates to a considerable extent the mathematical precision required by the Gonin technic, the tedium and trauma of the Lindner-Guist operation, and the postoperative trauma of each of these methods. In short, by electrocoagulation, the same end is obtained with a minimum amount of trauma, with greater accuracy, and, consequently, with a much higher percentage of good results. The technic is within the possibilities of the average operator who may have a sufficient number of cases at his disposal to master the details of properly placing the micro-

pins, after careful localization of visible tears. If tears are not uncovered, only experience can guide one in placing the punctures so that tears, although visible, may be included.

The success of the operation is dependent upon the same basic principles as those involved in practicing the Gonin or Lindner-Guist technic. If the operation is practiced with care, satisfactory results should be obtained in a majority of cases. It is a bit early to state as yet what percentage of cases will yield to this method. Thus far in my own experience, the number of successful cases greatly exceeds the results obtained by other methods.

In the January, 1934, issue of the American Journal of Ophthalmology, Series 3, vol. 17, No. 1, Clifford Walker discussed in detail his electrical unit, needles, equipment, and much of the technic which I follow. I will discuss especially certain phases of study, preparation, and technic, which, in my experience, form the basis upon which success depends.

Search for and localization of tears. Much has been written with a view to simplifying the exact location of tears. In my experience, exact localization is not easy by any method. I find the Gonin plan as easy of execution and as accurate as any. The meridian in which the tear is located offers no difficulty. This can be expressed in degrees as indicated on an approved perimetric chart. Simpler and less confusing is the designation of the meridian by the numerals on the face of a clock.

The distances from the macula and ora serrata are determined with less ease but careful measurements in disc diameters from the macula are sufficiently accurate for practical purposes. It is equally important, if possible, to make similar measurements in disc diameters from the ora to the tear. In my personal experience, the distance from the macula is most vital and can be obtained with greater accuracy. One may not succeed with a single examination, but if studies are repeated with suitable changes in the patient's posture, one can finally determine with sufficient accuracy the location on the sclera in millimeters from the limbus or ora serrata, to proceed with confidence in one's ability to seal or occlude tears which may be visible or invisible. Assuming in a 24-mm. globe that the outside measurement on the sclera from macula to ora serrata is 23.85 mm. and from macula to limbus 31.85 mm., each millimeter represents 3.77°. Inside measurement obtained in the same manner from macula to ora serrata is 21.86 mm., each millimeter representing 3.65°. For practical surgical purposes measurements are estimated on the outer scleral surface.

The accompanying table is self-explanatory and will serve as a ready guide in determining in millimeters the distance from limbus or ora serrata to the tear as seen in the fundus. A rapid and accurate method of locating such tear on the sclera will be described in discussing the placement of the micropunctures.

Even though electrocoagulation admits of a moderate degree of allowance for error, an approximate localization of the tear or areas to be sealed by micropunctures is a *sine qua non* for successful results. There is, therefore, no short cut to success which does not include thoroughness in localization.

Preparation and anesthesia. Like all eye surgery which requires precision, after satisfactory localization, the second step which makes for success is proper preparation, including anesthesia. Rest in bed, with limitation of intake of fluids and good elimination, is essential for several days before the operation. Locally, the eye should be treated as for any other intraocular surgery. Cultures should be taken, cul-de-sacs should be clean, and the lacrimal excretory system should be properly prepared. A final cleansing should be administered two hours before operation. The pupil should be fully dilated and an occlusive sterile dressing applied. Morphia and atropine are given hypodermatically before the patient is sent to the operating room.

General anesthesia should be omitted. If the patient envinces too much anxiety, avertin in full measure should be used, if it is not contraindicated. In

TABLE SHOWING DISTANCE ON THE SCLERA IN MILLIMETERS FROM MACULA TO ORA SERRATA AND LIMBUS; AND THE VALUE OF EACH MM. FROM THE MACULA EXPRESSED IN DEGREES

From Macula		To Ora Serrata	To Limbus
mm.	Degrees	mm.	mm.
1	3.77	22.85	30.85
2	7.54	21.85	29.85
3	11.31	20.85	28.85
4	15.08	19.85	27.85
5	18.85	18.85	26.85
6	22.62	17.85	25.85
7	26.39	16.85	24.85
8	30.16	15.85	23.85
9	33.93	14.85	22.85
10	37.70	13.85	21.85
11	41.47	12.85	20.85
12	45.24	11.85	19.85
13	49.01	10.85	18.85
14	52.78	9.85	17.85
15	56.55	8.85	16.85
16	60.32	7.85	15.85
17	64.07	6.85	14.85
18	67.86	5.85	13.85
19	71.63	4.85	12.85
20	75.40	3.85	11.85

few cases, however, is there failure to respond to local anesthesia supported by morphia and atropine.

The usual cocaine instillations are supplemented by retrobulbar injections of two-percent procaine in normal saline solution. The conjunctiva over the proposed operative area is infiltrated and if muscles are to be detached, their sheaths are also infiltrated with the same solution. Good anesthesia will insure a smooth and uneventful operation, which will probably consume from thirty to fifty minutes.

Exposure of field of operation. One should have a clear conception of the field to be covered and adequate exposure of the entire area should be made before the actual punctures are placed. 1. In most instances, when working on the temporal side of the eye, a free canthotomy will aid materially in furnishing adequate exposure. 2. A Guist speculum is of great value in obtaining free access to the operative field. 3. Incision of the conjunctiva and capsule should be placed well back and should extend to the sclera. 4. If punctures are to be placed well back of the limbus, one or two of the recti should be detached. In most instances detachment of one muscle will be adequate but two may safely be detached. A number-one braided or number-six twisted silk, doubly armed with needles is introduced with a whip stitch in the outer and inner thirds of the vertical recti, or upper and lower thirds of the lateral muscles, three or four millimeters back of the stump. The muscle is cut leaving at least one millimeter of stump. A similar suture is now mattressed through the stump to act as a retractor.

Charting of the field to be treated. The sclera is now freely exposed, and its surface dried. Having previously tested the electrical unit, one proceeds to outline on the scleral surface the exact area to be treated. Guide sutures have been recommended to mark the meridian in which the tear may lie. I find it better to locate the meridian 8 mm. from the limbus, over the ora serrata, by lightly coagulating this spot with a stilus in the insulated electrode handle. This serves the double purpose of permanently marking the meridian and locating the ora serrata from which all measurements are made. Guide sutures may be displaced but marks so placed remain as permanent guides throughout the operation. With Walker's millimeter curved ruler, the extreme posterior apex of area to be treated is marked in a similar way or a needle with white silk attached is placed as a posterior guide.

Placing of the microneedles. Needles

are placed rapidly as previously outlined, the punctures being arranged approximately two millimeters apart. If a tear has not been uncovered, micropins are placed as far posteriorly as previous studies seem to indicate. Only experience and judgment can guide one in this phase of the procedure. In my own work, this is determined by careful and repeated inspection of every fold of detachment, to uncover a tear or an area of choroiditis. By accurate observations, one can conclude how far back of the ora serrata the coagulation points should be placed so as to include invisible tears. In most instances, a second line of needles is placed two or three millimeters back of the ora serrata to include peripheral tears which may be located near the ora serrata. Finally to insure proper drainage, I place two or three large needles or quills mid-way between the posterior line and the line of secondary defense, so to speak.

In a number of cases, I find a complication in the form of thinned and ectasic sclera, as shown by bulging, bluish areas, which, I believe, mark the location of undiscovered tears. In such cases the anterior line of needles is so placed as to encircle such diseased areas. The significance of these areas will be referred to again before closing.

Drainage. All needles have been placed and remain *in situ* until coagulation punctures are completed. The silk threads are now gathered together, grasped as a single bundle and by a gentle rocking motion, aided by pressure of forceps, the needles are slowly withdrawn and placed *en masse* in a small bottle containing water. In withdrawing the needles, it is best to begin to remove those which are most posterior, so as not to injure healthy retina with the needle points as the fluid is allowed to escape. Subretinal fluid flows freely and this is aided by gentle massage of the surface by moistened cotton applicators.

Reattachment of muscles. The muscle is reattached to the stump and the conjunctiva and capsule are closed with interrupted silk sutures. Careful technic should be practiced in reattachment of the muscle. True enough, little difficulty is experienced in securing good union to the muscle stump, but one should aim to eliminate any shortening with subsequent disturbance of muscle balance.

After treatment. Both eyes are closed with a pressure bandage and the patient is returned to bed with the head placed in a favorable position for drainage. The eyes are dressed on the third, fifth, and seventh days. On the seventh day, the fundus is inspected. Daily dressings are applied for another week, when pinhole goggles are prescribed. Conjunctival sutures are removed on the seventh day. Muscle sutures may be removed at the end of two weeks or more.

In three weeks the patient is allowed out of bed and, as strength returns, greater activity is permitted, and goggles are removed.

As a rule, at the end of seven days, the retina is found to be flat. The vitreous gradually clears and the small areas of coagulation are recognizable as pale whitish areas which gradually become whiter, more circumscribed, and, in the course of a few weeks, the edges are surrounded by increasing deposits of pigment.

At the end of four weeks, adhesions seem to be firm, and, if the micropunctures are regularly placed two millimeters apart, the areas are in close contact and form spots of choroiditis about the size of the disc.

In five or six weeks, the patient may begin to resume some of his normal activities.

Tears

Much has been written pro and con on the rôle of retinal tears. In many instances they cannot be visualized. My own belief is that whether visible or invisible they play a dominant rôle in retinal detachment. If, by good fortune or wise planning, they are included in the coagulated area, results are good. If one fails to seal such tears, subretinal fluid will return and detachment will progress. Oftentimes instead of tears, an area of choroiditis is observed. In my cases, I have always planned to include such areas, and, thus far, I have

had failures in but two instances, which were old cases of some years' standing and in which I did not hope to effect cures.

Spots of choroiditis should be looked upon with suspicion, as the probable source of the leakage when frank tears cannot be found. I referred to a number of ectasic points on the sclera posterior to muscle attachments. I believe them to be of great significance. They probably represent diseased areas which extend from the sclera to choroid and retina, and probably bring about circumscribed areas of choroiditis, which mark the beginning of many cases of detachment in which frank tears cannot be recognized. It is also probable that in such cases, as well as other instances of localized areas of choroiditis, Sourdille effected many cures by creating a diffused choroiditis by means of chemical irritants. So few have been in accord with Sourdille in his beliefs that accurate localization is unimportant, that I have not referred to any extent to his method.

In Walker's paper referred to, he gives a brief history of the work done with varied forms of electrocoagulation. I wish to refer to but one item of his discussion; namely, Dr. F. H. Verhoeff practiced this method and published his paper in January, 1917, in the Ophthalmic Record. This is not generally known, and it is but fair to him that credit should be given where it is due.

One is little concerned as to whose equipment is used, so long as the procedure is satisfactory. Up to the present time, the Walker unit, his needles, and method of use surpass any equipment that has been brought to my attention. It is all that one could expect in accuracy, refinement, and completeness. I first used a unit imported from Germany, but found it clumsy and uncertain. The Safar insulated needles are too large and the method of placing them in the sclera is clumsy. In Walker's unit there is little left to be desired.

The outlook for retinal detachment

I have followed and practiced the several methods which have been offered recently on a number of cases sufficiently large to be able to make a fair estimate of their value. While my series of cases of electrocoagulation has not been large up to the time of writing this paper (twelve of the sixteen cases under study), I have had but two failures, which should not be included because of their long standing. These cases include at least one over more than a year's duration. They are illustrative of a fairly varied series of etiologic factors, and areas of detachment from a quadrant to three quadrants in extent. From these facts and the results of others whose reports have appeared in the literature, the future of retinal detachment is as hopeful as in the past it was hopeless. The immediate results, and recoveries observed months after operation are excellent. Only time can tell whether the areas of chorioretinal adhesions brought about by electrocoagulation may cause subsequent pathology. I am hopeful for permanent cures. With increased experience and care as to accuracy in each detail, electrocoagulation for retinal detachment seems to be most promising.

1930 Chestnut Street.

CONSERVATIVE TREATMENT OF MASSIVE CYSTOID FOLLOWING CATARACT EXTRACTION

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Three cases are reported to show the results of an operation for the reduction of enormous cystoid ectases which developed after cataract extraction. The ectases had been produced by the accumulation of aqueous, the anterior and posterior chambers in the affected eyes having been cut off from each other by the iris membrane. The cystoids were treated by lacerating the lower portion of the iridocapsular membrane with a Ziegler knife needle, thereby establishing communication between the chambers. In a few weeks the bulgings of the irides decreased and shrank—in one case entirely—and all three eyes now have useful sight. Read before the Section on Ophthalmology, College of Physicians in Philadelphia, February 15, 1934.

In 1932, three persons consulted me because of exactly similar conditions, namely, mature senile cataract in the right eye, and discomfort in the left eye occasioned by a staphylomatous cystoid supervening on a previously performed extraction of cataract. Each person was blind and helpless, greatly depressed psychically because of hopelessness, having in mind the recollection of many weeks of infirmity after the former cataract operation. Today, each, after the extraction of cataract in the second eye, is able to see well and is capable of carrying on the accustomed daily occupations, having been afforded useful sight in the eye with the ectasia, also.

In March, 1932, Mrs. R.M.C., aged 76 years, in a state of marked decrepitude, querulous, unkempt, and blind, was all but carried into my office. Her right eye contained a mature cataract; the left, presented chronic blepharoconjunctivitis and injection of the globe, the upper one fourth displaying a huge sausagelike ectasis. Singularly, there was no pain; and the eye was not tender. Light and shadows only, could be appreciated.

The patient had had failing sight because of cataracts since 1920. In 1929, the left eye had been operated on, but, at the second dressing, she was told a prolapse of the iris had occurred. Hospitalization was continued for two months, during which time she was urged repeatedly to have the eyeball removed. About four weeks after hospitalization another surgeon performed some operation, necessitating the insertion of stitches; no further treatment was given.

On April 11, 1932, I extracted the right crystalline lens by ordinary combined procedures and without accident. Recovery followed without incident.

On May 18, I attempted in the left eye an iridocapsulotomy with a Ziegler knife needle. There was not sufficient depth to the chamber to permit the insertion of the blade without lacerating the membranous sheet. The membrane was very dense and difficult to incise even with the perfect blade employed; however, finally, a more or less purposeful incision was made, and a rhomboidal opening secured. For several days the aqueous chamber was filled with blood and capsulolenticular debris, but, by June 7, there was a clear opening which allowed some view of the fundus. Before the end of the month a plus 10 lens was given with addition for near.

A remarkable change had taken place in the patient's morale and a great increase in her general strength. She went off to the seaside until September. On her return I was astonished to see that the ectasis had shrunk to a remarkable extent, that the patient could read easily with each eye small types and the newspaper, and that vision was 4/3 fully. The opening in the iris in the left eye enabled me to explore the fundus, which was healthy.

When last examined in November, 1933, full 4/4 and small types could be read with each eye, while in the left eye only a slight elevation of the cystoid was visible and the globe had been free from pain.

The second case to be detailed is that of F.B., a male, aged 63 years, who consulted me on August 30, 1932.

In October, 1931, his left eye had been operated on for cataract, and had become so inflamed that he was kept in the hospital for many weeks, having been told that erysipelas had set in, inflaming the skin of his face and eyelids. He was advised to have the eye removed, but would not consent. In the succeeding months he was in miserable health and despondent because of his helplessness, the right eye being reduced to light perception.

When examined by me, there was a hypermature cataract in the right eye, through which light was perceived and projection obtained promptly in all fields. The left globe presented a densely leucomatous cornea with slight vascularity. At the upper sclerocorneal juncture, were two large cystic ectases projecting from a whitish line, as though from a dense cicatrix. Light could be perceived in all directions. The iris seemed to be adherent to the leucoma, thus abolishing the anterior chamber. The appearance of the globe resembled a ciliary staphyloma. The eye was constantly irritated by the lashes from a deeply in-turned lower lid. There was marked eczematous dermatitis, aggravated by the constant flow of tears from the irritated eye.

On September 14, 1932, after making a small peripheral iridectomy, I removed the crystalline lens from the right eye, the extraction being completed with the aid of capsule forceps. The patient was highly nervous, and required sedatives. On the third night he became wild and pulled off his dressings, yet his recovery was entirely satisfactory, except that mydriasis could not be maintained because of the painful dermatitis that was set up by the use of atropine and other allied solutions.

The ectasis in the left eye was judged to be dependent upon the pressure on the iris from the accumulation of aqueous in the posterior chamber, as noted in the first case. It appeared probable that drainage of the fluid might be secured by effecting the formation of a channel into the anterior chamber. Therefore, on October 10, an iridotomy was attempted with a Ziegler knife inserted at the outer limbus. The blade having been insinuated across the stretched iris, a puncture was made near the bottom of the vertical meridian, and an upward slit effected, followed by a cross cut. The thick and fibrous iridocapsular sheet was incised with difficulty. Much thin vitreous flowed out into the aqueous through the aperture and through the external knife puncture, followed by free hemorrhage. Only slight reaction supervened so that by the fifth day the eye had become quiet, the hyphemia translucent, and, to my astonishment, the two ectases had become umbilicated. Soon thereafter, they rapidly collapsed, so that by the end of December they had shrunk markedly. In November, an attempt was made to sever the fibrous strands spanning the "hole" in the iridocapsular membrane.

For several weeks, the skin of the lids and cheeks continued to be rough and fissured. In December, several punctures were made in the left lower lid with the galvanic needle, resulting in a satisfactory eversion of the cilia so that the globe was no longer irritated by them. In the meantime, the bloody detritus in the aqueous had become absorbed, and, by March, 1933, it was possible to make out details of the fundus. In May, great comfort was afforded by an aphakic correction, which, by the end of June, enabled the man to see 4/22. By this time the ectases had become flattened to their present appearance, the dermatitis had healed, the entropion had been greatly relieved, and the patient could go about alone and live an enjoyable existence. Some time before Christmas the patient was not well, perhaps it was the grip, since when the sight of the left eye has not been as acute as formerly.

Without doubt, what was regarded as "erysipelas," which set in after the first cataract was operated upon, was in reality an atropine dermatitis. When it was repeated during my care of the man, its manifestations were indeed alarming to the nurses, who believed it indicated erysipelas, and who, because there were obstetric patients in the house, pleaded that the man should be taken away. Each subsequent use of even a weak solution, or oily suspension was fol-

lowed by redness and edema of the skin.

The third case presented local conditions quite similar to those in the first case. A cataract extraction was performed on the right eye, and the iris sheet of the left eye slit, with visual and pathological sequences quite like those observed in that case. The details of this history will be related in a future communication.

These cases as presented are based on the features which each offered at the first glance. So massive were the ectases, and so feeble the patients, that anyone would with reason have hesitated to expose them to the strains which arise during plastic operations devised for the obliteration of extrusions in the ciliary regions, such as in the reduction of a staphyloma. On closer study, however, it appeared that in no case was there thinning of the ciliary region, the ectasis being confined to iris tissue, over which was spread a delicate conjunctival membrane. In effect, the condition was like that found in iris bombé, where the anterior chamber is cut off from the posterior, in consequence of which the accumulated humor distends and bulges the thinned iris membrane. It was deemed wise, therefore, not to attempt an excision of the bladderlike ectasis, nor yet to puncture it. Accordingly, my design sought to make an opening in the iris membrane within the chamber, hoping thereby that the ectasis might collapse and shrink in a short while.

My expectations were fulfilled by the simple procedures instituted. The removal of the cataract from the right eye and the effects of what was done on the left so promptly revived the exhausted morale of each of the afflicted persons that one may regret that the procedure had not been carried out earlier.

315 South Fifteenth Street.

KERATOPLASTY

III. Report of seven cases

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Partial penetrating keratoplasty was performed on an unselected group of patients, using the author's specially designed instruments and technic. The results would thus indicate what type of pathology in the donor eye and what conditions in that of the recipient make for a favorable outcome. Data were lacking as to the probable postoperative course, so conservative measures were adopted.

Results indicated that eyes in which a moderately dense leucoma with portions of clear cornea contiguous to the intended graft, and in which the leucoma is the only pathological condition are best suited to the operation. The transplant should be taken from an enucleated eye whose cornea is entirely clear; not from a glaucomatous eye; and the donor should preferably be young.

Anterior and posterior transillumination are often helpful in examining patients with dense leucomas which spread over the entire corneal area.

From the Institute of Ophthalmology, Columbia Presbyterian Medical Center, New York City. Read before the Section of Ophthalmology of the New York Academy of Medicine, January 15, 1934.

A critical study of the literature published on keratoplasty shows (1) that up to the present time, of the three methods of corneal transplantation—total, partial superficial, and partial penetrating—the last offers the best permanent results, and (2) that the transplant must be obtained from the same individual (autoplasty), or from individuals of the same species (homoplasty). Heterotransplants invariably become opaque.

Experimental work on eyes of rabbits with normal[1, 2, and 3] and leucomatous[4] corneas proved that homokeratoplasty can successfully be accomplished when a suitable technic is followed. The encouraging results obtained from operating upon rabbits' eyes justified the trial of the operation upon human beings. The object of this paper is to report the results in the first seven human subjects operated upon by following the same technic, that of partial penetrating keratoplasty, which had previously been used on rabbits' eyes.

In order to determine the manner in which more or less severely affected eyes would react to this particular type of operation, no selection of cases was made. No precedence having been established as to the most favorable type of eye from which the transplants could be obtained, eyes which had been enucleated on account of different pathological processes were used, and in which the cornea was left normal or almost normal. The blood of the donor was tested for the presence of luetic infection.

It is not the purpose of this paper to present statistics, becasue they do not reflect the value of the operation in the average uncomplicated case, but to report a few more cases, the results of which, compared with those reported by other investigators, using the same or a different technic, might lead to the solution of this very important problem.

Some of the patients were operated upon with much skepticism as to the final visual result, but, the eye being in such very poor condition, operation seemed to offer the only possibility of restoring some vision.

The limited experience obtained in the study of these seven cases does not justify drawing definite conclusions. A brief comment will be made, however, after each case, in an effort to explain the postoperative behavior in relation to the clinical findings before and during the operation.

In some cases of leucomatous cornea, the leucoma, although sufficiently dense to cause a considerable impairment of vision, allows a good examination of the anterior segment of the eye by the ordinary means of exploration, such as the ophthalmoscope and slitlamp. Information is thus obtained about the thickness of the cornea, nature of the opacity, depth of the anterior chamber, pupil, and whether or not an anterior or pos-

terior synechia is present. The lens also can be examined if there are some transparent areas in the cornea.

When the leucoma is very dense, the usual methods of examination do not yield sufficient information, and in such cases transillumination is a most valuable aid. This can easily be effected with an ordinary electric ophthalmoscope provided with a condenser. The examination is performed in a dark room. The transilluminator can be applied to the eye behind the region of the ciliary body (fig. 1: A, B, C, D). The light will pass through the pupil, surgical colobomas, and atrophic areas of the iris and ciliary body, revealing something of their shape and position. When the light is turned on and off, the transilluminated pupil may either dilate or contract regularly all around, indicating a free iris, or part of it may dilate, while the rest remains immobile, (fig. 1: C, D), the immobile portion indicating the site of an anterior or posterior synechia. Absence of pupillary reaction to light stimulation will indicate that there is a large anterior or posterior synechia.

The anterior chamber can also be examined by transillumination, using the method described by Mendoza[1] for the study of the angle of the anterior chamber. In this method, the transilluminator is applied at the limbus in front of the insertion of the iris (fig. 1: E, F, G, H). If the anterior chamber is free from synechia it will appear with a bright uniform illumination (fig. 1: E, F), not only in the opaque or translucent cornea, but also at the limbus in the opaque sclera, corresponding to the region of the angle of the anterior chamber. Anterior synechiae will be seen as dark areas, whether peripheral or central, in the illuminated anterior segment (fig. 1: G, H).

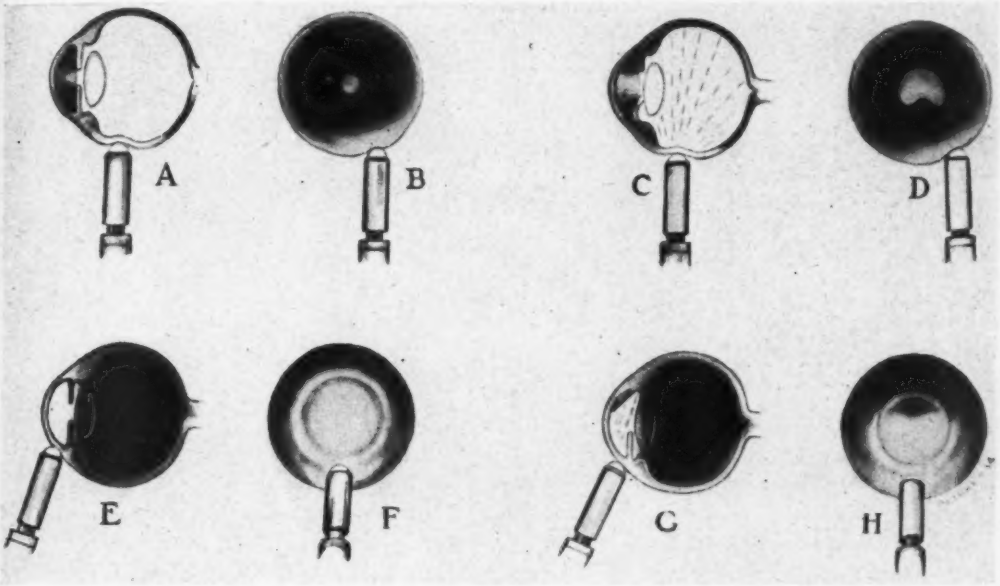

Fig. 1 (Castroviejo). A and B: cross section and front view of a posteriorly transilluminated normal eye, C and D: cross section and front view of a posteriorly transilluminated eye with posterior synechia. E and F: cross section and front view of a normal eye, using anterior transillumination. G and H: cross section and front view of an anteriorly transilluminated eye with anterior synechia.

Operation

Preparation of the patient. A detailed study of the patient's general condition is made, eliminating foci of infection, in an attempt by all means to bring the patient to the operation in a normal general condition, or as nearly so as possible.

Smears and cultures are taken from the

conjunctival cul-de-sac, but we are, as yet, uncertain as to what importance should be ascribed to the results of these cultures. Hemolytic staphylococcus aureus has been found in many cases in which the operation was successful, without evidence of infection. On the other hand, this organism is a frequent cause of postoperative panophthalmitis. Hemolytic streptococci and pneumococci are found less frequently and it would probably be prudent to delay the operation when these are present.

ments to be used in the operation, the double-bladed knife (D), keratome (E), and scissors (G), having been especially designed for this technic. The double-bladed knife is provided with detachable blades made of razor-blade steel. They are very sharp and should be tested on kidskin. discarding them if the points or edges are not in very good condition. The separation of the blades can be regulated to the desired width, which experience has shown to be 4 mm. If the transplant is larger than 4 mm., there is danger

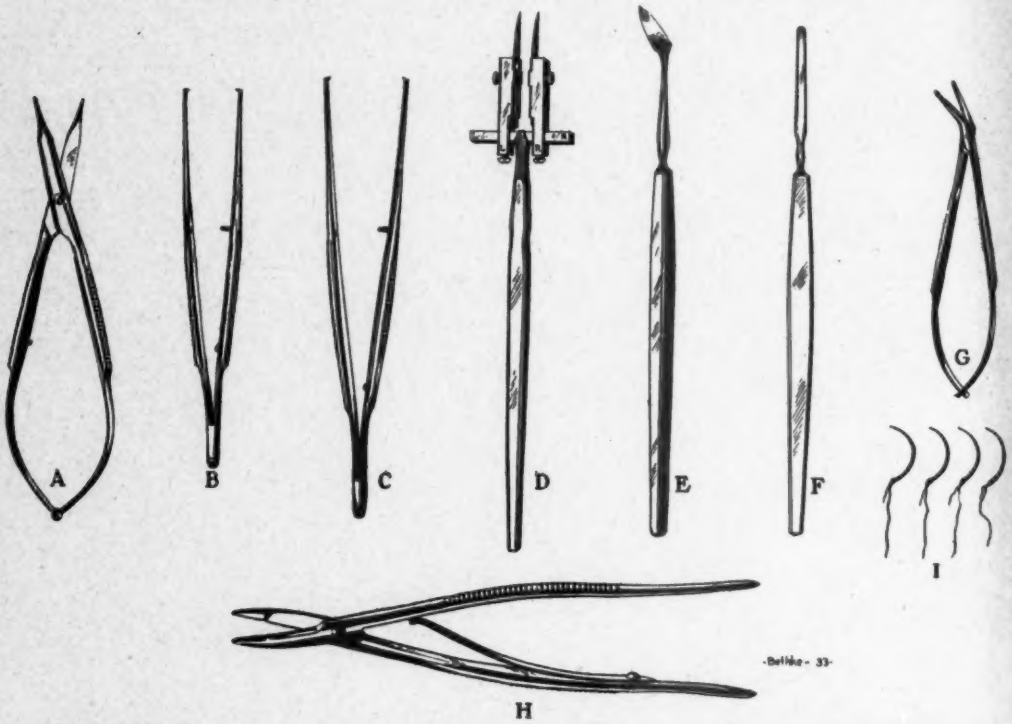

Fig. 2 (Castroviejo). Instruments required for author's method of partial penetrating keratoplasty: A, scissors; B, conjunctival forceps; C, fixation forceps; D, double-bladed knife; E, keratome; F, spatula; G, scissors for cutting cornea; H, author's model of combination needleholder, scissors, and forceps; I, single-armed sutures. (The instruments are made by V. Mueller and Company, 1853 W. Van Buren Street, Chicago, Illinois.)

A dose of sodium amytal is given two or three hours before the operation. Argyrol, a 20-percent solution, is instilled in the eye and the pupil dilated with a 3-percent solution of atropine sulphate. In the presence of anterior or posterior synechiae, iridectomy should be performed a few months prior to the corneal transplantation in order to liberate the iris from the area in the cornea where the transplant will be located. The transplant invariably opacifies if the iris becomes adherent to it.

Local anesthesia is preferable to general anesthesia in that it eliminates postoperative unrest, which would threaten the success of the transplantation.

Instruments. Figure 2 shows the instru-

of incarcerating the iris between the transplant and cornea of the recipient. If the transplant is smaller than 4 mm., the proliferation of connective tissue during the healing process might include the small central area of the transplant, with subsequent failure of the operation.

The keratome is 4 mm. wide and has been especially designed to cut accurately one of the edges of the transplant.

The special scissors are provided with dull points to avoid injury to the lens, and are shaped in such a way as to make it easy to hold them at a certain angle to obtain uniform beveling of the edges of the transplant.

Surgical procedure. A routine preparation

of the eye is made ten minutes before operation with a few instillations of a 4-percent solution of cocaine and a solution of adrenalin, 1/1000; immediately before the operation, a 20-percent solution of argyrol is again instilled followed by another instillation of cocaine and adrenalin. Paresis of the orbicularis is produced, following Van Lint's technic. A retrobulbar injection of 1 c.c. of a 2-percent solution of novocaine and adrenalin, 1/10,000, is given and a few drops of cocaine, 2 percent, and adrenalin, 1/10,000, are injected above and below under the bulbar conjunctiva. Separation of the eyelids is maintained with either a speculum or a central suture inserted in the skin of each eyelid near the eyelashes. Pulling of these sutures allows the eyelids to be separated without interfering with the different steps of the operation, as sometimes happens when a speculum is used in patients with small palpebral fissures.

Conjunctival incisions (fig. 3, A. Frontispiece) are made above and below near the limbus, leaving two zones, one on each side of the horizontal meridian through which the conjunctival incisions do not reach.

The conjunctiva above and below is undermined until two flaps are made which can be stretched with the aid of forceps towards the center of the cornea, covering the central area from 8 to 10 mm. along the horizontal diameter. Four sutures, about 3 mm. apart, are placed in the margins of the conjunctival flaps (fig. 3, A). The flaps are drawn again over the central area of the cornea where the transplant is to be located, to make sure that the flaps cover this area uniformly and not with excessive tension. The conjunctival sutures are drawn back from over the cornea. The eye is fixed with Elschnig fixation forceps (fig. 3, B); which should take hold of the episclera below near the limbus. Then, the twin knives, adjusted to the desired separation, are used to make two vertical incisions. Changing the fixation, as indicated in figure 3, C, two horizontal incisions are made at right angles to the vertical ones in order to outline a square flap. These incisions act as guides to outline the corneal flap and are cut only from one third to one half the thickness of the cornea (fig. 3, D). Care must be taken not to exert too much pressure, which might lead to perforation of the cornea. Fluorescein is instilled to make these incisions stand out. The eye is again fixed, the forceps taking hold of the episclera near the limbus (fig. 3, E). With the special keratome, a penetrating section is made along the upper incision of the marked-out square at an oblique angle of 45 degrees in relation to the tangent plane of the cornea at the point of penetration (fig. 3, E, F).

The incision made with the keratome does not need to complete the section of the upper edge of the corneal flap, for in cases of shallow anterior chamber it is easy to injure the lens if the blade of the keratome is introduced too far into the anterior chamber. With the special scissors (fig. 3, G) maintained at an angle of about 45 degrees from the outside inward, in order to obtain uniform beveling, the section of the upper incision is finished as well as the other three edges of the corneal flap, the anterior surface of the flap being cut larger than the posterior surface.

The graft to be transplanted is obtained, in the same fashion as has been described above, from an eye which was enucleated while the eye of the recipient was being prepared. The enucleated eye is given to the surgeon performing the transplantation as soon as the dissection of the leucoma has been completed. Wrapped in gauze, it is held between the fingers (fig. 3, L), care being taken to exert neither too much nor too little pressure upon it. If too much pressure is exerted by the fingers, the anterior segment of the eye is stretched and the resulting excised corneal segment fits loosely. If insufficient pressure is exerted the excised segment is too snug for the opening made in the recipient eye. The dissected graft is lifted with a spatula (fig. 3, H, F) and, without being treated with any solution, is placed in the eye of the host in substitution of the resected portion of the leucoma. Once the transplant is in position, gentle pressure is applied with the spatula at the junction of the transplant and the cornea of the host (fig. 3, I) in order that the epithelial surfaces of both may be made level. The conjunctival flaps are then carefully pulled over the graft and the sutures tied (fig. 3, J, K). A 3-percent solution of atropine sulphate is instilled and metaphen ointment placed in the conjunctival cul-de-sac. Binocular noncompressive dressing is applied. (Figure 3, K, shows a cross section of the eye when the operation is completed.)

Postoperative care. During the first six days after the operation, the patient must remain in bed as quietly as possible, except that the head and back may be elevated if he is uncomfortable. The night of the seventh day after the operation a dose of Cascara is given the patient, followed the next morning by a small dose of milk of magnesia and an oil enema, retained for one hour, which produce a soft evacuation without effort. The first dressing is made two days after the operation for the purpose, only, of inspecting the eyelids; the eye is not examined. Four days later, the second dressing is made and the eye carefully inspected. Care must be taken not to exert any pressure that might lead to the detachment of the transplant. Metaphen ointment is applied and a binocular dressing replaced.

Subsequent dressings are made every other day with the application of metaphen ointment. If the patient has useful vision in the unoperated eye, it can be uncovered on about the tenth day after the operation. The postoperative course is different in each individual case, depending upon the condition of the eye. If the only pathology in the eye is the corneal leucoma, it is to be expected that by the sixth day after the operation the

conjunctival flaps will begin to separate. Two or three days later, the transplant may be uncovered. The conjunctival flaps will then have pulled away from the cornea. From eight days to three weeks after the operation, it is expected that the conjunctival sutures will fall out by themselves, but if some of them are still attached to the conjunctival flaps they can be removed and the eye uncovered.

In complicated eyes such as those with heavy scarring of the conjunctiva, hypertension, aphakia with loss of vitreous during the operation, the postoperative course may be prolonged. In these first cases operated upon, there was no definite information about the postoperative behavior of the average case, hence the attitude was adopted of being very conservative until more knowledge should be acquired and the safety margin of the postoperative course known.

The patient is given a fluid diet the first two days, semifluid during the following four days, then gradually returned to a normal diet.

Report of Cases

Case 1. Mr. H. R., aged 40 years, was first examined January 13, 1933, giving a history of having been burned in the left eye seven years ago with an acid, the nature of which he did not know. Since that time, vision in the left eye had been very poor.

Examination of the eye (fig. 4) revealed a very dense vascularized corneal leucoma, extending over the whole area of the cornea. Posterior transillumination showed the pupil to be centrally located, reacting actively to light. Upon instillation of atropine, the pupil dilated uniformly. Anterior transillumination showed the anterior chamber to be free from both peripheral and central synechia. Intraocular tension was 19; vision, 5/200. Smear and culture of conjunctival secretion were negative.

The right eye was normal in every respect. Vision was 20/15. The patient appeared to be in good general condition and complete examination failed to detect any pathology, save for the leucoma of the left eye.

Keratoplasty was performed on February 21, 1933. At the time of operation, while inserting the conjunctival sutures, the conjunctiva was torn on the nasal side. A new suture was inserted which pulled the conjunctiva unevenly, thus producing a vertical line of tension. In order to diminish the tension, the conjunctiva was buttonholed above and below the point where the pressure was uneven. The above maneuver left the conjunctival flaps exerting apparently even pressure throughout.

Donor. Miss A.P., aged 20 years, at four years of age suffered a fall which resulted in loss of vision in the left eye. Examination of the eye showed the lens to be dislocated and extraction was performed. Four years ago, the donor had an attack of uveitis, followed by secondary glaucoma for the treatment of which iridectomy, trephining, and cyclodialysis were successively performed.

Finally, in view of a clinical diagnosis of uveitis, aphakia, secondary glaucoma, band keratitis, and a tension of 48, enucleation was advised. The eye was painful and vision nil.

The cornea, at the time of operation showed some opacities, but there was an area 4 mm. square which seemed to be in good condition to yield a corneal flap for transplantation. However, there was slight epithelial edema. When the transplant was dissected, the edema of the cornea had increased, which was probably due to the action of the anesthetics and the maneuvers of the enucleation. It was difficult to complete the dissection of the transplant because the eye collapsed as soon as the keratome incision was made.

Microscopic examination of the donor's eye revealed a collapsed globe, making examination of the pathological processes very difficult. It could be said only that there existed an old uveitis which, apparently, had run its course and had become quiet. There appeared to have been an old corneal scar, the result either of injury or ulcer. Into this scar the iris and ciliary processes were drawn. The choroid was detached, unquestionably the result of the globe's having been opened.

Postoperative course. The patient had an attack of coryza and tonsillitis during the first few postoperative days. Ten days after the operation, the transplant was in position and edematous. The upper conjunctival flap was adherent to the nasal edge of the transplant and the anterior chamber had reformed. An attempt was made to loosen the conjunctival adherence to the transplant and, while doing this, the nasal edge of the transplant became detached. Aqueous humor drained, the anterior chamber became shallow for a few days, and there was a slight hypertension. Cicatrization took place afterwards without further complications and the transplant gradually became nebulous and, finally, opaque.

Vision, at present, is fingers at two feet. The cornea looks as if no operation had been performed (fig. 5). Pupil, anterior chamber, and intraocular tension seem to be in the same condition as before the operation.

The patient is ready to undergo a second operation for corneal transplantation.

Comment. Had a more adequate history been taken before the operation, it would have revealed that the patient was subject to frequent sore throats and colds, especially during the winter. Diagnosis of chronic tonsillitis was made July 18, 1933. The tonsils were removed and were found to be enlarged, caseous, and full of crypts. Probably the postoperative attack of tonsillitis did not greatly influence the outcome of the corneal transplantation, but it is reason-

Fig. 4 (Castroviejo). Case 1. Before operation.

Fig. 5 (Castroviejo). Case 1. One year after operation.

Fig. 6 (Castroviejo). Case 2. Before operation.

Fig. 7 (Castroviejo). Case 2. Six months after operation.

Fig. 8 (Castroviejo). Case 3. Before operation.

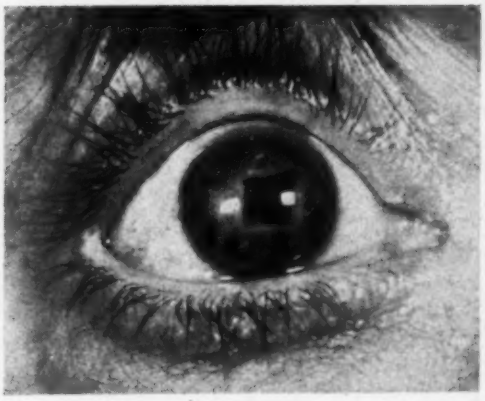

Fig. 9 (Castroviejo). Case 3. Five months after operation.

able to suppose that it did not help the situation. The eye of the donor was obviously not in condition to be used for a corneal transplantation.

It was difficult to dissect the transplant because the eye collapsed when the anterior chamber was opened. The transplant, at the time of the operation, was quite edematous and slightly cloudy. This cloudiness did not disappear during the postoperative course, and it became gradually more intense after the perforation of the anterior chamber, which occurred when the attempt was made to loosen the conjunctival adherence to the edge of the transplant. The attempt to loosen this conjunctival adherence was another false step in the procedure, because it led to the formation of a fistula and an attack of hypertension. Operating upon animal eyes has shown that when a fistula is formed the transplant becomes either nebulous or opaque.

Case 2. Miss I. L., aged 22 years, had a corneal leucoma of the left eye, the sequela of an ammonia burn (fig. 6).

The intraocular tension, anterior chamber, and pupil where normal. Vision was light perception and projection. The right eye was normal, with vision equal to 20/15. Blood grouping B (iii). Keratoplasty was performed July 28, 1933, with no complications.

Donor. Mrs. E.G., aged 51 years, had a history of a breast amputation several years previously because of cancer.

The first examination of the eye, two months before, disclosed a complete detachment of the retina and hypotony. Ten days ago, the eye became painful with elevation of intraocular tension. Immediately before enucleation the tension was 45 mm. A slight edema of the epithelium was detected with the slitlamp. Blood grouping O (i).

Microscopic examination of the enucleated eye revealed a carcinoma of the choroid and secondary glaucoma.

Postoperative course. The transplant was edematous at the first dressing and gradually cleared up during the following days, but not completely. Vision, three weeks after the operation, was fingers at two feet. One month after the operation, hypertension developed. The transplant became nebulous and vision diminished to hand motion at one foot. Myotics had no effect on the tension. A large iridectomy was performed, September 15, 1933, followed by a normal recovery. Tension has been normal ever since. After the iridectomy, the nebulosity of the transplant cleared up considerably (fig. 7) and, at present, the patient is able to count fingers at two feet.

Comment. This patient was apparently predisposed to glaucoma and it would have been good judgment to have performed a wide iridectomy previous to the operation for corneal transplantation. The transplant obtained from the glaucomatous eye was slightly edematous when placed in the eye of the host. The edema of the transplant was present at the first dressing and never cleared up completely.

A definite conclusion cannot be drawn from the study of this single case, but it seems reasonable to suppose that glaucomatous eyes, especially if the corneal epithelium has undergone some changes, do not offer the most satisfactory material for corneal transplantation. If the vision of this patient does not improve in the near future, a second corneal transplantation will be advised.

Case 3. Mr. A. F., aged 51 years, had a corneal opacity of the right eye as a sequela of corneal ulcer (fig. 8), complicated by iritis and secondary glaucoma five years ago. The anterior chamber, pupil, and intraocular tension were normal. Vision was limited to hand motion at one foot. The left eye was normal, with vision equal to 20/15. Blood grouping A (ii). Keratoplasty was performed August 24, 1933, without complications.

Donor. C. K., aged 29 years, had a clinical diagnosis of sarcoma of the choroid in the macular region. Vision was 20/40; intraocular tension normal. The cornea, at the time of the operation was perfect. Blood grouping O (i).

Postoperative course was uneventful. The transplant was entirely transparent at the first dressing, six days after the operation. Three weeks postoperatively, vision was 20/80, with pinhole 20/40. Vision and transplant have remained unchanged (fig. 9). Looking through the transparent transplant with the slitlamp, some pigment deposits were detected on the anterior capsule of the lens, sequela of the old iritis.

Comment. In this case, the cornea of the donor was in excellent condition at the time when the transplant was dissected and the eye of the host was ideal for undergoing a corneal transplantation. The corneal opacity was the only pathology left in the eye. The patient had been under observation for a few years, evincing no tendency to hypertension.

The study of this case shows that the corneal transplant does not necessarily have to be edematous during the first

few days, as has been pointed out by some writers. The presence of edema in the transplant seems to be due to a preexisting edema in the cornea of the donor, poor nutrition of the transplant during the first few days, as happens when the transplant is entirely surrounded by scar tissue, or protection with the conjunctival flaps is defective, or the fitting imperfect, which allows either aqueous humor or tears to penetrate into the transplant. Therefore, if the transplant has been obtained from a perfect cornea, has been properly dissected without traumatism, and if there is good coaptation of its edges with those of the cornea of the host, it can be expected that no edema will be present in the transplant at any time, or, if present during the first few days, that it will be very slight.

Case 4. Mr. R. F., aged 34 years, stated that four years ago his eyes, face, and hands had been severely burned by the explosion of a container in which several caustics were kept.

Examination of the right eye showed a very dense corneal leucoma (fig. 10) with some vessels penetrating from the limbus radially towards the center of the scarred cornea. The leucoma was so dense that there was only a very faint distinction between the scarred cornea and the conjunctiva. The inferior cul-de-sac was normal. The superior fornix had been partially obliterated and there existed a central symblepharon. Posterior transillumination revealed an immobile, small, round pupil, centrally located. Anterior transillumination seemed to indicate complete obliteration of the anterior chamber and, therefore, a large or total anterior synechia. Intraocular tension was 23 mm., using Baillart's tonometer. Vision was good light perception and doubtful projection with the ophthalmoscope; with the slitlamp beam the projection was fairly good in every direction excepting toward the nasal side.

The upper lid of the left eye was totally adherent to the cornea. Tension was 45 mm. with Baillart's tonometer; vision, nil; blood grouping A (ii).

Keratoplasty was performed September 26, 1933, and revealed that the cornea was at least twice its normal thickness, that the iris adhered to the cornea, and that there was an opaque lens. The iris was incised all around the corneal opening and through the same opening an extracapsular cataract extraction was performed. The transplant was placed in position and the conjunctival flaps sutured in the usual manner.

Donor. Mrs. M. W., aged 58 years, complained of having had recurrent attacks of iridocyclitis after which vision failed gradually. At the time of the operation vision in the left eye was nil. The cornea presented some opacities, but an area at the upper temporal quadrant had a normal appearance with the slitlamp and was sufficiently large to allow dissection of a corneal flap for transplantation. At the time of the operation, this flap was slightly edematous.

The report of the microscopic examination of the donor's eye follows:

(1) Phthisis bulbi, following infection.
(2) Retinal detachment, following myopia and hemorrhage.
(3) Cornea, pannus degenerativus.
(4) Iris, atrophy without proliferation and entropion uvea.
(5) Degeneration, bone in choroid and calcium in lens.

Postoperative course. Healing took place without complications. During the first two weeks, the transplant remained transparent, but edematous. Through the transplant the anterior chamber could be seen containing cortical remnants of the lens and some blood. Afterwards, the transplant gradually became nebulous. In November 23, 1933, the anterior chamber was opened at the limbus, below, and the iris, being found adherent to the temporal edge of the transplant, was freed, and a large iridectomy performed below. Lens remnants came out and with them a drop of normal vitreous. At present, the transplant is opaque (fig. 11). Vision is good light perception and projection.

Comment. This was a very unfavorable case for corneal transplantation. The operation was performed because of the very bad condition of the eyes and because it offered the only possibility, although very remote of restoring some vision. The specific object of the second operation was to remove the lens remnants and the synechia, preparing the cornea for a second transplantation.

Case 5. Mrs. L. G., aged 55 years, presented an extensive corneal opacity in the left eye, a sequela of old trachoma (fig. 12). Vision was hand motion at one foot. The intraocular tension, anterior chamber, and pupil were normal. Blood grouping A (ii).

At operation, September 29, 1933, the cornea was found to be very thin and the lens cataractous. There was a marked trachomatous contraction of the conjunctiva, which caused it to be easily torn while the flaps were being dissected.

Donor. Mr. H. B., aged 44 years, complained of sudden loss of vision two months ago. Diagnosis was made of retinal detachment, due to melanosarcoma of the choroid. Vision was light perception in the temporal field. Intraocular tension was 16 mm; blood grouping O (i). The cornea, at the time of dissection of the transplant, was in

perfect condition. Microscopic diagnosis of donor's eye: sarcoma of the choroid.

Postoperative course. The transplant was transparent at the first dressing, six days after the operation. Four weeks afterwards, the transplant was still transparent, the anterior chamber very shallow, while vision was hand motion at two feet. A few days later, the tension increased to 50 mm., uninfluenced by myotics.

On October 10, 1933, a large iridectomy was performed above. An uneventful recovery took place and the tension has been normal ever since. The transplant is still transparent (fig. 13), the lens opacities have increased, and the anterior chamber has remained shallow. Vision is good light perception and projection. A cataract extraction will be performed when the eye has completely recovered from previous operations.

Comment. The eye of this patient was potentially glaucomatous, due to the heavy scarring of the conjunctiva around the cornea. The operation for corneal transplantation was perhaps the cause that definitely brought about the hypertension through the combined action of the following factors: (1) Traumatism of the conjunctiva and subsequent development of connective tissue around the limbus; (2) the opening of the anterior chamber, which became shallow, interfering with normal filtration; (3) the formation of a dense aqueous humor which also resulted in difficult filtration; (4) the rapid swelling of the lens.

It is well known that any one of these four factors, individually, could produce a temporary or permanent rise of tension; hence, it would have been good judgment to have performed the iridectomy previous to the keratoplasty in order to have prevented the increase of tension of the eye.

Case 6. Mr. G. F., aged 69 years, who had a history of old interstitial keratitis in both eyes since childhood, had had an optical iridectomy and tattooing in the center of the cornea of the right eye several years previously.

Examination of left eye: Vision was 6/200. The whole thickness of the cornea showed a nebulous infiltration and a few old interstitial vessels. There was a faint, small, brown area in the center of the cornea, the evidence of tattooing with gold chloride, and a marked arcus senilis. A large iridectomy had been performed above for optical purposes. The anterior chamber was normal, as was also the intraocular tension. The pupil reacted very slightly to light.

Examination of life eye: Vision was 20/200. There was interstitial infiltration of the cornea with a few interstitial vessels. The anterior chamber, tension, and pupil were normal.

Past general history revealed that the patient had had scarlet fever and smallpox in infancy; typhoid fever forty years ago. He had had trouble with his eyes since the attack of smallpox.

On February 15, 1933, diagnosis was made in the Vanderbilt Clinic of benign hypertrophy of the prostate, varicose veins in the lower legs, and retention cyst in the right tonsillar fossa. Later, diagnosis was made also of general arteriosclerosis, mild heart failure, and senility.

On February 18, 1933, a bilateral vasectomy was performed and on February 27, a suprapubic prostatectomy and blood transfusion.

The patient stated that on July 26, 1933, he had had a mild stroke without loss of consciousness. Neurological examination revealed only slight left facial weakness. Blood Wassermann was negative.

Keratoplasty on the right eye was scheduled for September but had to be postponed on account of the poor general condition of the patient. The operation was finally performed November 11, 1933, without complications. The cornea was found to be highly sclerosed.

Donor. Mrs. S.M., aged 64 years, had a clinical diagnosis of sarcoma of the choroid. At the time of operation, the cornea of the donor also was found to be sclerosed and offered a marked resistance to being cut while the dissection of the corneal transplant was being made. Microscopic diagnosis of donor's eye: sarcoma of the choroid.

Postoperative course. The patient had a number of attacks of coughing the first day after operation. The second day he was restless, moving his head about a great deal. The dressing was removed the third day after the operation. The eyelids were quite edematous and the conjunctiva chemotic. There was a marked yellowish infiltration of the cornea and of the transplant. The anterior chamber was full of pus. Twenty-four hours later, the eye was enucleated. Culture of the pus revealed the presence of a very hemolytic staphylococcus aureus.

Microscopic examination of the enucleated eye revealed the cornea and the transplant to be necrotic and heavily infiltrated with leucocytes. The infiltration extended inward to other intraocular structures.

Comment. The poor general condition of this patient might not have been directly responsible for the fulminant endophthalmitis, but his inadequate organic defences with lack of resistance to operation should have been taken into consideration to contraindicate surgery. The sclerosis of the cornea of the

Fig. 10 (Castroviejo). Case 4. Before operation.

Fig. 11 (Castroviejo). Case 4. Three months after operation.

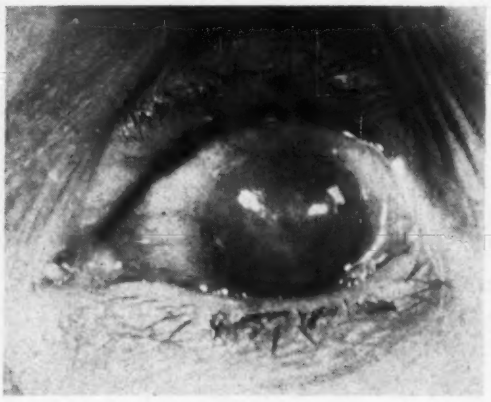

Fig. 12 (Castroviejo). Case 5. Before operation.

Fig. 13 (Castroviejo). Case 5. Three months after operation.

Fig. 14 (Castroviejo). Case 7. Before operation.

Fig. 15 (Castroviejo). Case 7. Twenty-eight days after operation.

donor leads one to conclude that eyes of young people are more satisfactory material for corneal transplantation than the eyes of old persons in which more or less sclerosis and less vitality of all the tissues are to be expected.

Case 7. Mr. W. B., aged 24 years, was first examined July 25, 1933. The right eye showed marked horizontal nystagmus and dense corneal leucoma (fig. 14), the sequela of gonorrheal infection at birth. Transillumination revealed a pupil, small, irregular, slightly deviated upwards, and an iris totally adherent to the posterior surface of the leucomatous cornea. The intraocular tension was markedly increased to fingers; vision was light perception and projection.

The left eye showed a dense central leucoma, also the result of gonorrheal infection at birth. There was a rim of peripheral transparent cornea around the leucoma. A large iridectomy had been performed above, for optical purposes. The lens presented an anterior polar cataract. The iris was adherent to the posterior surface of the cornea at "6 o'clock." The anterior chamber above was of normal depth. Vision was fingers at one foot; tension, normal.

In December, 1933, the patient returned for a second examination, two operations having been performed on the right eye to liberate the cornea from the anterior synechia. Transillumination showed that the upper temporal quadrant of the iris had been removed, leaving an eccentric area of cornea free from synechia above and temporally, where a corneal transplant could be placed. Vision was light perception and projection; tension, 40 mm. using Baillart's tonometer. The left eye remained unchanged. Blood grouping O (i).

Keratoplasty was performed December 19, 1933. At operation, it was found that the lens was absent, the vitreous had herniated through the corneal opening and would not allow a good fitting of the transplant. The so-called hyaloid membrane was purposely broken and a very small amount of vitreous was removed with a swab until this fluid did not show further tendency to prolapse. The transplant was then placed in position and the operation finished in the usual manner.

Donor. A boy, H.M., aged 6 years, whose vision was 3/200, presented clinical manifestations suggestive of tumor of the retina, and enucleation was advised. The intraocular tension was normal; the cornea in a perfect state of preservation at the time of operation. Blood grouping A (ii).

Microscopic diagnosis: pseudotumor of the retina.

Postoperative course was uneventful. The transplant remained transparent (fig. 15). On January 15, 1934, the patient was discharged with vision of fingers at three feet.

Comment. Taking into consideration that this was a rather complicated case because of (a) amblyopia, (b) the dense leucoma, (c) absence of lens, (d) hypertension, and (e) loss of vitreous, the result might be considered quite successful. Hitherto, various authors have stated that corneal transplants cannot preserve transparency unless the transplant is surrounded by nonscarred cornea. Absence of lens has also been considered a contraindication for corneal transplantation because of the danger of loss of vitreous, with subsequent impairment of healing, leading to opacification of the transplant.

The case here reported seems to disprove such a statement, indicating that when a proper method is used those factors can be disregarded. The cornea of the donor used in this case was very easily dissected, which seems to confirm the opinion that corneas of young people are better suited for transplantation than those obtained from older persons.

Summary and Conclusions

It has been the purpose of this paper to point out that homokeratoplasty in human beings can be successfully accomplished when a suitable technic is followed.

The principal features of the technic already given in detail are: (1) to obtain a rectangular graft, 4 mm. square, corresponding exactly in size and beveled edges in both the transplant and the opening in the cornea of the recipient, with the anterior surface of the graft larger than the posterior surface; (2) the use of conjunctival flaps to hold the transplant in position, giving a gentle uniform pressure, accelerating the process of healing, and furnishing necessary nutrition while cicatrization takes place during the first few days. The conjunctival flaps also make a water-tight union favoring the prompt restoration of the anterior chamber, and finally, they offer the best possible protection for the graft and the eye in case the former becomes partially detached or does not heal.

The technic of partial penetrating keratoplasty, such as the one described above, will give the best results in those eyes in which the whole pathology is

limited to the cornea, the leucoma being not very dense, and in which there are zones of little- or nonscarred cornea surrounding the transplant. In eyes with dense corneal leucomas in which the transplant is entirely surrounded by dense scar tissue, in those with aphakia and loss of vitreous during the operation, hypertension, etc., the results cannot be expected to be so brilliant, but inasmuch as the vision in these eyes is limited to light perception and projection, or only perception, and the corneal transplantation offers the only means to improve the vision, operation is advisable.

Eyes with heavy scarring of the conjunctiva around the cornea are predisposed to glaucomatous attacks, hence it would be good judgment in these cases to perform a large iridectomy previous to corneal transplantation.

Transplants should be obtained from enucleated eyes in which the cornea has been left entirely unaffected. Transplants should not be taken from glaucomatous eyes because the cornea is always more or less affected by the pathological process and the transplant has a tendency to remain edematous and afterwards, nebulous.

Enucleation of the donor's eye should be performed, if possible, under general anesthesia to avoid injury of the corneal epithelium which almost always occurs when local anesthesia is used. Eyes of young people seem to furnish better material for transplantation than those of older persons.

The importance that should be ascribed to blood grouping in corneal transplantation is to be determined when the operation has been performed in a large number of cases. Blood grouping was made in the six last cases reported and in each instance it was found to be different in the donor from that in the recipient.

In examining patients with dense leucomas extending over the whole area of the cornea, posterior and anterior transillumination is the most valuable method.

One Hundred Sixty-fifth Street and Port Washington Avenue.

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Discussion: DR. BEN WITT KEY: I wish to congratulate Dr. Castroviejo upon his studies and experiments on this very interesting problem. I believe he is thinking along correct lines of endeavor.

Since it now has been definitely shown that the cornea can be transplanted, it is my conviction that the problem is not only a delicate surgical task, but also is dependent upon a chemical background. For many years it had been regarded as a surgical problem dependent upon the nourishment of the transplant. With this in mind it was my purpose to supply this nourishment by transplanting the whole cornea together with a large circumcorneal conjunctival flap. This was accomplished, and was reported in detail before the American Ophthalmological Society, in 1930. Although the corneoconjunctival transplant was a complete "take," the cornea very gradually became opaque over a period of two years, but this took place with no loss of substance whatever, with normal conjunctival repair, and without hypertension. The conclusion to be drawn from this case is that the corneal substance, like the lens, is probably affected by contact with aqueous—a chemical or nutritional change—since Descemet's membrane does not repair and therefore permits the entrance of aqueous into the corneal substance.

Elschnig's operation and modification of it, in which corneal substance alone is transplanted by trephine or by partial removal

of it, is dependent upon clear or partly transparent corneal substance. In these cases some nourishment is present and supplied in clear substance. Also it must be remembered that in these cases some vision is already present and little if any is to be gained. In cases of complete opacification of the cornea—the most desirable for a corneal transplant, since no vision whatever is present—it is quite evident that the corneal transplant, after Elschnig's method, is not the operation of choice, because the nourishment of the opaque fibrous cornea is insufficient to maintain the transparency of the transplant. Therefore, in these cases, I believe transplantation of the whole cornea—corneociliaroplasty—after the technic which I reported in 1930, to be the operation of choice. It is quite evident, however, that in these cases the chemistry of the problem is the task before our future experimenters.

DR. CASTROVIEJO: Did the patient have hypertension afterwards?

DR. KEY: He did not have hypertension two years afterwards. The direction of the keratome section was from the limbus forward, in order to make the dissection of the cornea very superficial, and to protect the iris angle. My study of the subject led me to use this method because in complete opacity of the cornea, the fibrous corneal tissue does not permit nourishment of the small transplant, and sooner or later it becomes opaque. Dr. Gradle sent a beautiful case to me, in which Elschnig had transplanted the central portion of the cornea of each eye, but you could see that the corneal transplant was just as opaque as the corneal substance about it before the operation. This goes to show that the chemistry of the cornea, or the nourishment of the cornea possible for maintaining transparency of the graft, is dependent on the transparency of the rest of the cornea.

One can make a conjunctival flap about the cornea and dissect it with a knife forward as far as a millimeter and a half into the deep corneal substance, and then one can use a blunt spud and tease it forward in the deep substance—along Descemet's membrane—and simply strip the whole cornea free from Descemet's membrane. I think, if I had another case of complete corneal opacity, I would try to dissect the two corneas off in this manner for transplantation. One might cut into Descemet's membrane, but if one could possibly prevent extensive contact of corneal substance with aqueous, I believe we might succeed in having some clear corneal substance maintained.

DR. ISADORE GOLDSTEIN: I have done some of this work experimentally upon animals, but have no experience with it in the human. I have seen some of Dr. Castroviejo's work, and have been very much impressed. I saw Sir Tudor Thomas's work at Cardiff, England, two years ago, and at that time he was getting one hundred percent satisfactory results in rabbits. Not alone was he transplanting the cornea, but also the sclera. Recently he has done some work on the human with very good results.

DR. RAMON CASTROVIEJO (closing the discussion): The sections of the eye with a corneal transplant, presented by Dr. Samuels, showed that the number of corneal corpuscles is increased. A new membrane has formed behind the endothelium, and the epithelium is thinned. The histologic findings in this eye are similar to those that we have found in eyes of animals with opaque or nebulous transplants. In our experiments we have found that the transplants which have remained transparent have normal histologic structures, including that of the epithelium. The sections of the eye of the donor, which were presented by Dr. Samuels, showed that the edges of the cornea are very irregular, especially towards the deeper layers of the stroma, near Descemet's membrane. Asher, in 1922, proved that the trephine produces irregular corneal incisions. We arrived at the same conclusion in 1932 (American Journal of Ophthalmology, September and October, 1932), and also concluded that linear incisions are cleaner than those made with the trephine.

Dr. Key stated that the problem of corneal transplantation is to be solved by chemistry. The penetration of the aqueous humor into the corneal stroma is probably responsible for the nebulosity and subsequent opacification of the transplant. Dr. Key thinks that if the transplant is made without injuring Descemet's membrane, the aqueous would not be allowed to penetrate into the corneal stroma, and the transplant would remain transparent. We think, as Dr. Key does, that the aqueous humor is the enemy of the cornea as it is the enemy of the lens, and therefore should not be allowed to remain in contact with the unprotected corneal stroma any longer than is necessary. If the size and shape of the transplant is perfect and it fits the defect of the cornea of the host, it will make an almost water-tight closure. The endothelium of the transplant and that of the cornea of the recipient will be in direct contact and will regenerate rapidly, covering the gap made by the incision and separating the aqueous humor from the stroma. This is the reason why, in our opinion, the method of Thomas, who uses a smaller trephine to cut the transplant than to excise the leucoma of the cornea of the host, may prove in the future to be defective in technic.

In some of the transparent transplants we have obtained in animals, it is seen that, at the posterior surface of the cornea, the endothelium, slightly thinned at the side of the incision, was in contact with an area of corneal stroma where Descemet's membrane had not yet had time to regenerate. The endothelium, therefore, seems to be more important than Descemet's membrane for the protection of the corneal stroma.

In regard to the transplantation of the whole cornea, it is obvious that the operation is a difficult one. It is almost impossible to obtain the same shape and size in both corneas, donor and host. The incision is very near the iris, almost always an anterior synechia develops, the eye degenerates from

glaucoma or phthisis bulbi and invariably becomes blind. This has been found in all cases reported in the literature—Filatow and Schimanowsky in 1913, Burke in 1921, Elschnig in 1922, Key in 1930, and Katz in 1932. The method suggested by Dr. Key of peeling the corneal scar down to the whole surface of the cornea, leaving Descemet's membrane and endothelium, and placing in this bed the superficial layers of the whole surface of the cornea with a rim of conjunctiva obtained from the donor's eye, seems almost impracticable in our present-day knowledge. Besides, connective tissue has to develop between the cornea of the recipient and that of the donor with subsequent nebulosity or opacification of the transplant.

In reply to Dr. Goldstein, who very justly praised the method of Thomas whom he saw perform the operation on rabbits, I must say that last June I saw Dr. Thomas operate in one human case using this technic. The operation was very beautiful and was performed very skillfully. It could not have been performed on a patient with a thin cornea, and it seemed to be a difficult operation to popularize.

It is not our contention that with the new technic the problem of corneal transplantation has been solved. The object of the presentation was to report a few cases in which operation was by the new method, some of the cases with very encouraging results. We hope that this presentation will awaken the interest of the specialists in this important problem and its solution. I want to thank you for your kind attention, and express my appreciation to Dr. Wheeler and his associates, who, with their active cooperation, have made possible the accomplishment of the work here presented.

A CASE OF CHOROIDAL ATROPHY WITHOUT NIGHT BLINDNESS

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This is a case of bilateral choroidal atrophy with pigment migration to the inner layers of the retinae without contraction of fields and without night blindness, in a seven-year-old female child. The condition was probably due to some biliary toxemia associated with one or more severe attacks of liver malfunction, followed by prolonged jaundice. This case is compared with Verhoeff's case of retinitis pigmentosa to confirm some of his conclusions and to bring out certain contrasts between this type of case and that of retinitis pigmentosa. Read before the Eye Section of the New York Academy of Medicine, February 19, 1934.

This case is of interest both because of the probable etiology and because night blindness is absent. I wish to bring out certain similarities and certain contrasts between it and Verhoeff's[1] case of retinitis pigmentosa, which tend to confirm some of his observations, and to suggest some points for further study.

A pathologist has attempted to get a blood specimen for a Wassermann test but sent word that he had not obtained enough blood for that purpose. Further efforts will be made in the future definitely to rule out syphilis. In the meantime the family history is all that we can go by.

Report of case

F.M., a female child, aged 7 years, the daughter of a Boston physician, was brought to me in October, 1933, for correction of poor vision of a year's duration, apparently not progressive. The father's own Wassermann test, once taken as routine, was negative; the mother belongs to a family of known heritage of noted people among whom specific disease was most unlikely; there have been no miscarriages in the family nor in either ancestry; there have never been any deaths of uncertain or unusual cause. The child's second front teeth are normal. The media and fundi of the mother, father, older brother, and younger sister are all normal. I feel safe in suggesting from the known circumstances that the ocular condition involved is probably not syphilitic.

History: The patient was born in May, 1926, by normal delivery, had measles in 1928, and was a fat, healthy child. In February, 1929, three others in the family had "Flu." This child coughed very much and was severely prostrated. After several days she became drowsy and then semicomatose with marked anorexia and breath of

acetone, making a slow recovery after 5 days. There were recurrences in 1930 and 1931 with severe cold, semicoma, acidosis of 5 days' duration, and slow recovery, leaving the appetite and strength below par. With the third attack, in 1931, there were diarrhea, foul, fatty stools, and jaundice, followed by a very slow recovery. The jaundice was especially persistent and recovery to normal color returned only a few months ago. At the time of writing (February, 1934) she still has marked anorexia, is susceptible to colds, very easily fatigued, and decidedly undernourished. Orientation in the dark is not reduced.

Examination: Natural vision = 20/70 in each eye; pinhole vision = 20/50 in each eye. The pupils were normal in activity and rather large; convergence was normal; the fields, tested by fingers, were not remarkable, nor was there abnormal nystagmus. Corrected vision under cycloplegia was

Right +3.75 D. sph. ⌯ +0.50 D. cyl. axis 90° = 20/50.

Left +3.00 D. sph. ⌯ +1.00 D. cyl. axis 80° = 20/50.

Ophthalmoscopic examination showed O.U. media to be clear, with no vitreous opacities seen. The fundi revealed a diffuse, marked, peripheral choroidal atrophy with choroidal vessels of larger size very prominent against the white scleral background. The choriocapillaris was partially affected around each disc and macula, and gone peripherally; many pinpoint and larger pigment flecks had migrated from the pigment epithelium layer into the inner layers of the retinae, especially peripherally and around each macula. The retinal vessels were not remarkable; the discs pinkish in color without any waxy appearance; edges clear, no elevation; physiological cups normal; no hemorrhages nor exudate seen.

The color sense with test yarns was excellent.

Fields: With a 1° white object these showed no contraction in either a bright or a dim light.

Color fields: At the first test, ½° objects, were normal but the patient became quickly fatigued; when fatigued, the color fields were reduced to the tubular type. At the second test, taken during an attack of whooping cough when the patient was tired at the beginning of the test, with ½° objects they were markedly, concentrically contracted, almost tubular; with 1° objects they were normal. In each test the blue field was the largest of the color fields.

When the child is older an effort will be made to locate scotomata and to obtain a more definite record of fields than is possible at her present age.

The general physical examination was negative; neither liver nor spleen could be palpated.

The blood count was as follows:

Red blood cells	4,230,000
White blood cells	5,100
Polymorphonuclears	49 percent
Lymphocytes	35 percent
Large mononuclears	13 percent
Eosinophiles	2 percent
Basophiles	None

The red blood cells and blood platelets showed no abnormalities; hemoglobin by the Tallquist scale was 70 percent (normal).

Comment

Quoting from Verhoeff, who, in turn, was indirectly quoting from Leber[2], we find, "The essential retinal lesion in this disease (retinitis pigmentosa) was degeneration of the neuro-epithelium, the rods being first affected, and that as a result of this degeneration there occurred degenerative and proliferative changes in the pigment epithelium, with migration of the pigment cells into the retina, and growth of pigment cells around the vessels." Also, "That the choroid, including the choriocapillaris was not concerned in the process[3, 4, 5, 6]."

In Verhoeff's case the choriocapillaris was normal, and the choroid as a whole was normal except for senile vascular changes. He states, "It is obvious, therefore, that obstruction of the choriocapillaris or choroidal circulation can be dismissed as a possible cause of retinitis pigmentosa."

Although my case is not one of retinitis pigmentosa, we still can argue that, without night blindness, the rods are intact; therefore, with a marked degeneration and atrophy of choroid and choriocapillaris—with apparently nor-

mal rods—Verhoeff's contention that atrophy of the rods is not due to degeneration of the choriocapillaris is confirmed.

Verhoeff describes the neuroepithelium as the rods and cones with their fibers which pass through the external limiting membrane "forming the layer of Henle, and their nuclei the external nuclear layer." He believes that degeneration of the neuroepithelial layer, which constitutes one third of the retina, is sufficient to produce the gliosis of the retina and also to produce the characteristic changes in the pigment epithelium. In my case there is very little, if any, gliosis of the retinae as shown by normal-sized blood vessels and no waxy appearance of the discs[7], but there is a marked change in the pigment epithelium. The change in pigment epithelium in his case and in mine is essentially the same, in that the pigment has migrated to the inner layers of the retina; but in my case there is less proliferation, especially around and along the blood vessels, which in retinitis pigmentosa is supposedly due to the gliosis of the retina and the hyperplastic changes in the vessel walls, and which produces the characteristic "hen scratch" or "bone corpuscle" pigment deposits. My case, therefore, confirms his further statement, "The possibility is not excluded—that in retinitis pigmentosa the changes in the pigment epithelium are partly or wholly due directly to the same cause that leads to degeneration of the neuro-epithelium," by claiming that in my case, in which the choroidal atrophy is the most conspicuous ophthalmoscopic feature, whatever caused the choroidal atrophy also caused the degeneration of the pigment epithelium with little or no effect on the neuro-epithelial layer. Or else, this change in the pigment epithelium is the result of loss of nourishment. According to Fuchs[8] (p. 326), atrophy of the choriocapillaris results in atrophy of the visual epithelium, which is always associated with atrophy of the pigment epithelium, since both are nourished by the same source, and which is followed by migration of pigment into the retina and in front of the retinal vessels.

Agreeing with Verhoeff, that in his case of retinitis pigmentosa the primary lesion is the degeneration of the retinal neuroepithelial layer, and claiming that in my case the primary lesion is the degeneration or atrophy of the choroid, one may well ask, is there any relationship in the etiology of the two types of case?

Syphilis as a cause in my case has been considered and probably ruled out. It is so seldom present in retinitis pigmentosa that usually, at least, it is not considered as an etiological factor.

Consanguinity does not exist in my case, and, while classically a possible cause in retinitis pigmentosa, it seldom is present in these cases. In no case of retinitis pigmentosa that I have ever seen has it been present.

Verhoeff discusses "abiotrophy[7]" which he calls a "premature senility of specified tissues," as a possible cause of retinitis pigmentosa. This cannot be excluded in my case, and might be considered as a more possible cause than in retinitis pigmentosa, because of the similarity between my case and an advanced arteriosclerosis. It seems to me an unlikely cause in my case, partly because of the youth of the patient, and partly because of the definite history of a toxemia.

In regard to toxic influences as causative factors in retinitis pigmentosa, Verhoeff says, in part, that acting either through the blood stream or through the vitreous they could selectively affect both the rods and the neuroepithelium; perhaps especially the rods because of their smaller size. He notes the example of night blindness in cases of hypertrophic cirrhosis of the liver. He also quotes Takahashi[9] who found abnormal hepatic function in twelve cases of retinitis pigmentosa.

May I here state that a patient with retinitis pigmentosa, under my care from 1912 to 1925, died in a distant city at the age of 50 years, and that the only autopsy report I was able to obtain was that he had some chronic liver disease.

Fuchs (p. 316) under "Diffuse Choroiditis" states that in the later stages, atrophy of the retina and pigment migration supervene so that a picture similar to retinitis pigmentosa arises, and differs from it by the presence of

choroidal atrophy. "We come across similar findings at times in chronic disease of the liver with icterus. This occurs with the phenomena of hemeralopia as an inflammation of the choroid and retina with pigmentation of the same (ophthalmia hepatica)."

At the April, 1933, meeting of the Eye Section of the New York Academy of Medicine, Wexler[10] presented a specimen of the eye of "a patient, 2 days old, with icterus neonatorum. The choroidal blood vessels were swollen with large masses of pigment, while the choroid itself and the retina appeared intact. The pigment in this case was no doubt derived from the breaking down of pigment cells throughout the uvea, possibly owing to the toxic effect of the circulating bile."

There is, therefore, considerable evidence pointing toward hepatic malfunction as a toxic cause in these cases. My case, with one severe liver attack with jaundice and two other attacks of probable hepatic involvement without jaundice could come under this classification —except that there is no night blindness.

Verhoeff considers the possibility of the toxic effect being "due to an excess in the blood, of bile salts or other substances derived from the liver, and that these may affect the visual purple and the rods in which this substance is supposed to reside," . . . "which after a long time might well cause degeneration of the retinal neuro-epithelium."

Could it be, in my case, that the toxic cause went far enough to destroy the peripheral choroid and to affect the neuroepithelium by partially destroying the visual purple (as shown by the marked reduction in color fields during fatigue) but not far enough to destroy all of the visual purple or to produce night blindness? But, if this be true, and if the toxic effect had gone on to complete destruction of the rods and consequent night blindness, this case would not become one of retinitis pigmentosa because of the presence of choroidal atrophy and the difference in pigment deposition.

Granted that in my case the cause may be an hepatic malfunction, and that in at least some cases of retinitis pigmentosa the cause may be the same, why do these toxins in some cases select the choroid for the first attack with a result like that in my case, and in others select the rods for the primary attack as in retinitis pigmentosa? Verhoeff says that perhaps the rods are attacked first because they are of smaller size. This can hardly be correct in the light of the above comparative pictures.

The answer is probably a chemical one, involving a difference in composition of the bile salts, which, in these cases, may be in excess in the blood stream, the difference being that the rods may be susceptible to certain bile compounds and the choroid susceptible to others.

Is it not possible that pathological changes seen in ocular fundi at various ages with choroidal involvement and bizarre pigmentation are sometimes due to a previous acute or chronic liver malfunction rather than to some focal infection or syphilis or tuberculosis?

Doctors Allen Greenwood and W. Holbrook Lowell kindly saw this patient with me and have corroborated my ophthalmoscopic findings.

30 West Fifty-ninth Street.

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1934—THE SEMICENTENARY OF LOCAL ANESTHESIA

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September 15, 1934 was the fiftieth anniversary of the demonstration of the local-anesthetic effect of cocaine by Koller, before the German Ophthalmological Society at Heidelberg. This is a brief history of the discovery of the action of cocaine and includes an account of its many variants and derivatives. From the Department of Ophthalmology, Northwestern University Medical School.

Modern local anesthesia originated as a contribution of ophthalmology. The anesthetic action of cocaine on the cornea was discovered by an ophthalmologist, Carl Koller, and the earliest work in local anesthesia was in the field of eye surgery. The significance of Koller's discovery—presented at the Heidelberg Congress, September 15, 1884—was immediately grasped by ophthalmologists. Noyes prophetically concluded his enthusiastic report with: "It remains however to investigate all the characters of this substance, and we may find that there is a shadow side as well as a brilliant side in the discovery." Within a week following the Noyes letter, Agnew reported four eye operations done with cocaine, and Knapp's comprehensive paper in December, 1884, revealed that in less than three months after Koller's demonstration almost every conceivable eye operation had been attempted under local anesthesia. It may be here noted that Alexander Wood, the inventor of the hypodermic needle upon which modern local anesthesia so much depends, died in 1884, the year in which Koller made his discovery.

Though the interrelations of ophthalmology and medicine have been repeatedly stressed, the debt of general surgery to the ophthalmic specialists is not usually appreciated. Few realize, for instance, that the idea of Wolfe grafts originated in the surgery of an ophthalmologist, John Reissberg Wolfe, whose article, "On the transplantation of skin-flaps without pedicle," appeared in 1883. The most notable contribution of ophthalmology, however, has probably been the introduction of modern local anesthesia.

Just fifty years ago, in 1884, Carl Koller, then a budding ophthalmologist, 27 years of age, and but two years out of medical school, demonstrated conclusively that local surgical anesthesia could be accomplished by cocaine. His work gave this drug, which had hitherto been a chemical curiosity, its present

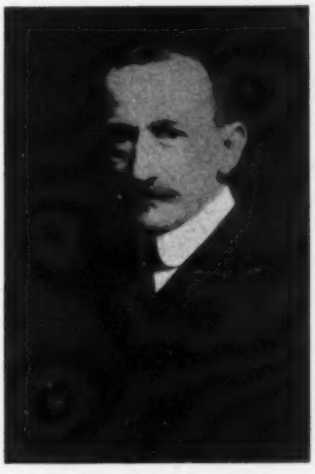

Fig. 1. Carl Koller, born 1857, now residing in New York City. The ophthalmologist who introduced cocaine as a local anesthetic in surgery.

definitive place in medicine. The lament of the early workers was the exorbitant cost of the alkaloid, but thanks to the demand and improved chemical methods of production, this was reduced in three years from $.27 per grain to $.05, a rate not far from its present market price.

Ophthalmology and rhinolaryngology were more affected by the introduction of local anesthesia than by that of general narcosis. Previous to the advent of cocaine, the only intranasal operation performed was the more or less exact removal of polypi. The laryngologists at first attempted to control the laryngeal reflexes by the topical application of

such medicaments as potassium bromide, chloroform, or morphine, which, however, proved either uneffective or dangerously toxic. Consequently, the attempts at anesthesia were soon abandoned, and the cooperation of the patient was sought through preliminary training, the daily practice often continuing for weeks and months before the surgeon considered the case ripe for operation.

Looking backward, the perspective of thoughts and events that lead to a great discovery is readily perceived; but at the contemporary period, the cross-currents of ideas are so confused that representative leaders may be totally unaware of the significance of previous investigations and may express conclusions diametrically opposed to the trends of development. In this connection, it may be noted that just fifteen years before Morton established the practicability of ether anesthesia, the famous Velpeau wrote: "To avoid the pain of operation is a chimera which follows one no longer." though in 1800 Davy had discovered the anesthetic action of nitrous oxide. and in 1818 Faraday had found ether likewise to possess this property. Similarly, almost on the eve of Koller's discovery, a British Medical Commission, investigating cocaine in 1880, reported that the drug was merely a poor substitute for caffeine.

It seems to us now incredible that discriminating men could be so oblivious of the significant contributions previously reported. The earliest investigators had noted the numbing of the tongue that followed the chewing of coca leaves (Scherzer). the tasting of the active principle (Gardeke, 1855). or the purified alkaloid (Niemann, 1860). In 1868, Moréno y Maiz observed that in the injected limb of the frog sensitivity was completely abolished; in 1869, Fauvel employed topically a strong alcoholic extract of coca leaves for painful affections of the throat. (Later a preparation. Mariani tea. the result of his work. enabled President Grant. who became afflicted with carcinoma of the larynx towards the end of 1884, to finish his Memoirs in the last five months of life.) In 1872, Bennett wrote that the surface application of cocaine reduced the sensibility of mucous membranes; in 1879, von Anrep reported that when his own skin was infiltrated with a weak solution of cocaine it became absolutely numb; and finally, in 1880, Coupard and Boudereau discovered that the instillation of cocaine into the conjunctival sac abolished the corneal reflex.

Though Moréno and von Anrep had suggested that the local action of cocaine might be of value in surgery, it remained for Koller to perform the crucial experiment. On his graduation from the Vienna Medical School, in 1882, he entered the Allgemeine Krankenhaus as a resident in ophthalmology. On account of the particular disadvantages and hazards of general narcosis in the surgery of the eye, most ocular operations were then done without any anesthetic whatsoever. Koller consequently became interested in the problem of local anesthesia for the eye. At the same time Sigmund Freud, now famous as the father of psychoanalysis, was testing the treatment of morphine addiction by the substitution of cocaine, and asked Koller to cooperate in some physiological experiments. Curiously, just as ether anesthesia indirectly originated from the bizarre notions of Beddoes on pneumatic therapy, so local anesthesia was indirectly derived from this misconception of Freud.

After tasting cocaine, and feeling a subsequent numbness of the tongue, Koller asked, is not this local anesthesia? He hurried to the laboratory and instilled a drop of cocaine solution into the eye of a frog, and then of a guinea-pig. After a few minutes he found the cornea and the conjunctiva insensitive to mechanical, chemical, thermal, and faradic stimulation. He next experimented on himself, his colleagues, and finally on patients. The official demonstration of the surface action of cocaine before the German Ophthalmological Society at Heidelberg, September 15, 1884, should rank historically with the famous first public operation under ether at the Massachusetts General Hospital, October 16, 1846.

The efficacy of cocaine anesthesia was

soon confirmed by the most famous ophthalmologists of the day—by von Reuss, Becker, Hirschberg, and Horner of Germany; by Panas, Vulpian, and Abadie of France; by Noyes, Agnew, and Knapp of America; and by Gunn and Nettleship of England. After Jellinek next had introduced cocaine into the practice of laryngology, his chief, Schrötter, prophetically averred: "The technical difficulties in laryngeal surgery have now been overcome." The use of the drug was forthwith extended to rhinology by Bosworth, to urology by Otis, and to gynecology by Fraenkel. Dastré aptly termed cocaine the curare of the sense nerves. Koller himself widened the field of cocaine in ocular anesthesia, by recommending subconjunctival injections in operations for cataract, iridectomy, and squint.

But the limitations and dangers of cocaine became shortly manifest. Deaths from hypodermic administration and from its use in laryngology, urology, and proctology impelled surgeons to develop a safer technic, and chemists to seek less toxic substitutes. In 1885, Halsted initiated conduction anesthesia by performing the first mandibular block for the extraction of a tooth. In the same year, Corning, another American, pointed out the marked value of constricting the circulation central to the site of operation; and also demonstrated spinal anesthesia in dog and man. After this, the interest in local anesthesia waned until Schleich and Reclus, in 1891, showed that the field of cocaine could be safely extended by using solutions of but 0.1-percent strength, injected very slowly, and with the needle constantly moving. In 1898, Cushing began blocking the larger nerve trunks, and in 1899, Bier for the first time attempted an operation on man—the removal of hemorrhoids—by the use of spinal anesthesia.

Meanwhile, in 1891, Giesel had isolated tropacocaine from the Java coca; and in 1896, holocaine, a phenacetin derivative produced by Tauber, and yohimbine, the alkaloid from the yohimbehoa tree, isolated by Spiegel, were introduced as surface anesthetics in ophthalmology. Modifications of cocaine were developed—alpha eucaine by Merling in 1896, and beta eucaine by Vinci in 1897. The latter, though a less efficient anesthetic, because of its reduced toxicity soon displaced cocaine for infiltration.

Surgeons had tried the admixture of astringents, such as antipyrine and resorcin, in the hope of both increasing the duration of anesthesia and minimizing toxic reactions. With the advent of adrenalin, isolated by Takamine in 1901, the ideal drug was at hand—a chemical tourniquet—as Heinrich Braun enthusiastically termed it. Local anesthesia owes much to the genius of Braun, and among his significant contributions is his immediate recognition of the value of adrenalin, and the popularization of its use.

Fig. 2. Heinrich Braun, born 1862, now residing in Ueberlingen, Germany. A pioneer and modern leading authority in the field of local anesthesia.

After Willstätter, in 1898, worked out the constitution of cocaine, Ehrlich promulgated the view that the entire cocaine molecule was not necessary for anesthesia. Inspired by his conception, the chemists proceeded along the line of his suggestions to devise better anesthetics. The property of local anesthesia was found to be characteristic of all compounds containing a benzoyl base and an alkyl radical in certain relations.

At first the relatively simple but insoluble amido-benzoates were constructed. These nontoxic preparations fulfilled the need for an effective soothing powder for ulcerated surfaces. The production of the ethyl derivative, benzocaine, by Ritsert in 1890 was succeeded by Einhorn's contribution of the methyl variation, orthoform; which was followed in turn by the iso-butyl derivative, cycloform; the propyl derivative, propaesin; and (since the World War) the butyl derivative, butesin.

In 1904 and 1905, various soluble modifications were introduced—stovaine by Fourneau, alypin by Impens, and novocaine by Alfred Einhorn. Novocaine is one of the supreme triumphs of synthetic chemistry. Though on injection as effective as cocaine, its toxicity is minimal. The maximum quantity of cocaine that a cautious surgeon may use is 0.1 gm., whereas over 4.0 gm. of novocaine have been employed in extensive operations without local irritation or toxic reaction. Novocaine was sponsored immediately by Heinrich Braun, and soon displaced all other local anesthetics for injection. The use of cocaine became limited entirely to surface anesthesia. Novocaine as an alkamine benzoyl ester is a type form of injection anesthetic from which even more variations are derivable than from the barbiturates, but, curiously enough, though the first of its type, it has not yet been surpassed in its field.

Synthetic substitutes challenge likewise the domination of cocaine as a surface anesthetic. Alypin was succeeded after the World War by butyn, which has twice the efficiency of cocaine in topical applications. Then followed tutocaine in 1922, isocaine in 1924, borocaine in 1925, nupercaine in 1929, pantocaine in 1931, and new-psicaine in 1933. Pantocaine is ten times more active than cocaine on the rabbit's cornea, but on injection is three times more toxic. The present goal of pharmacologic chemists is the production of an all-round local anesthetic, which, while possessing a powerful surface action, can still be safely and efficiently used for infiltration. Perhaps new-psicaine, the hydrochloride of benzoyl pseudoecgonin propylester, may fulfill the requirements. Unlike most substitutes for cocaine, it does not produce hyperemia, and its surface action is five times as powerful. It is likewise five times as effective as novocaine on injection, and, considering the reduced concentration needed, it should be no more toxic. Nevertheless, cocaine, because of its combined anesthetic, astringent, and mydriatic actions, is particularly adapted for certain eye operations, such as cataract extraction, and no other drug, as yet, has become so favored in this field.

Control over local anesthesia has been further enhanced by the discovery that the barbiturates can minimize or counteract the toxic symptoms of cocaine or of its synthetic substitutes. Since 1925, Tatum and his associates have demonstrated that after the previous administration of barbiturates animals survived up to four times the ordinary fatal hypodermic dose of cocaine or novocaine. Even after symptoms have developed, the convulsions can be arrested by the intravenous injection of a soluble preparation such as sodium pentobarbital or amytal.

In surveying this semicentenary of local anesthesia, medicine may well be proud of the progress achieved. Surgical technic has developed hand in hand with pharmacological advance, so that now, given the cooperation of the patient, almost any surgical venture can be as successfully undertaken under local as under general anesthesia. The monographs of the day indicate that the field of local anesthesia recognizes few if any technical barriers. In certain specialties, notably ophthalmology and rhinolaryngology, the adult layman has been educated to expect local anesthesia as the routine procedure.

310 South Michigan Avenue.

NOTES, CASES, INSTRUMENTS

A MODIFICATION OF THE HAITZ CHARTS

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Several disadvantages have become apparent in the clinical use of the Haitz charts. The continuous presence of the colored dot throughout the test is not desirable because in the act of binocular central fixation the color passes over a large portion of the retina before reaching the central area. The present modification is an attempt to overcome this and several other disadvantages.

In the center of the crossed lines of a Haitz chart, a hole of a given diameter is drilled; for our purposes a 1 mm. diameter has been found satisfactory in clinical use. A wheel, which has at least five apertures, is mounted on the back of the chart. Colored gelatine filters, in red, blue, green, and yellow, are placed in four of the openings; the fifth is left without a filter. The disc is so adjusted that by its rotation, the filters may be placed directly behind the opening in the card.

The card is placed in a stereoscope in the usual manner. The patient is seated with his back to the window and is asked to look at the circles. When binocular central fixation is assured, a small hand flash light is turned on for an instant about 1 cm. directly behind the aperture without a filter. Unless the patient has a complete central scotoma he will see the light. In the remainder of the tests, the colored discs are turned into place and the light is flashed when the examiner is certain that binocular central fixation is present. Normal patients are able to name the colors instantly. When the tests have been completed on one eye, the chart is turned, end for end, to place the aperture before the other eye. Central color scotomata are readily determined in this manner.

The modified chart has the following advantages over the original color chart:

(1) Fixation is assured before the color is shown, thereby assuring the stimulation of only the receptors of the central area.

(2) The intensity of light may be varied by changing the distance of the light source from the filter.

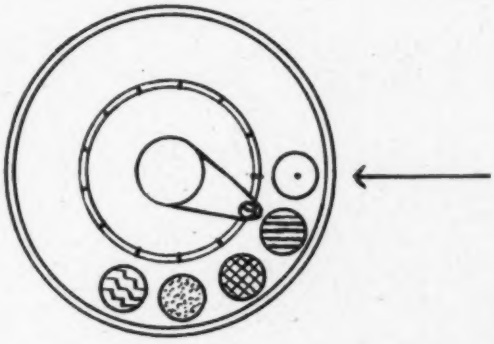

Fig. 1 (Walker). The reverse side of the modification of the Haitz Charts. The arrow indicates the aperture in the card and the position of the disc.

(3) The size of the aperture may be varied by the addition of an iris diaphragm.

(4) Only one chart is necessary, whereas five charts are used at present.

(5) The colors of the modified chart remain uniform over a much longer period of time.

(6) The chart may be made of metal, thereby providing durability for constant clinical use.

243 Charles Street.

ORBITAL FOREIGN BODY

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The following record, while perhaps of no marked scientific value, has some clinical interest. A man, aged 34 years, on Nov. 22, 1932, midnight, while driving an automobile down a steep grade in the mountains fell asleep. The unguided automobile turned over and rolled down a bank, finally landing in a tree and brush. When the patient re-

gained consciousness he was in a hospital two hundred miles distant.

Examination of the patient at the hospital revealed in the region of the internal canthus of the left orbit a large laceration. The wound contained wood, debris and a strip of skin and hair one and one-half inch long and three-eights inch wide, from the supra-

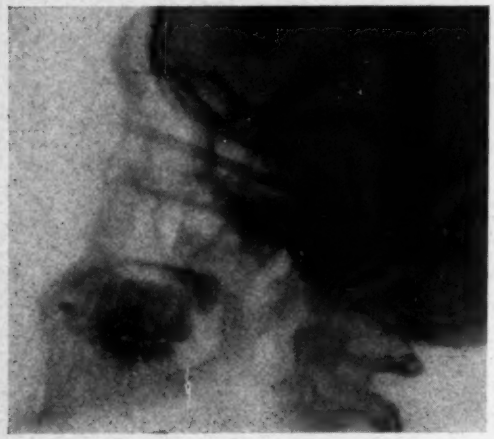

Fig. 1 (Harbridge). X-ray photograph with strabismus hook showing course and extent of large piece of wood.

orbital area. The eyeball was partly proptosed, the conjunctiva edematous. The anterior chamber was very deep, the lens dislocated down and posteriorly, tension mushy, the globe ruptured. Attempts at removal of the foreign material from the wound provoked such severe pain and hemorrhage that it was necessary to administer a general anesthetic. Many pieces of wood, debris, portions of the orbital plate of the ethmoid, and fragments of lachrymal and frontal bones were removed. The strip of skin containing the supra-ciliary hair was stitched in place. The hemorrhage becoming uncontrollable the wound was firmly packed and dressed. Two days later the ruptured globe was removed together with more fragments of wood and debris. Very deep in the wound to the nasal side was exposed a large pulsating vessel about half an inch in length. The anatomy of the parts was so disturbed that identification was difficult. The hemorrhage being very severe the orbit and the wound were again firmly packed and dressed.

Dressing the parts or any unusual movement of the head would precipitate a very severe occipital pain. These attacks of pain were not controlled by morphine and upon two occasions required a mild anesthesia with chloroform to control the spasmotic seizures. The temperature ranged from normal to 103 degrees. Roentgenograms showed no opaque material in the region involved. During the succeeding months the wound discharged a mucoid material and small fragments of wood were recovered. At no time was there a purulent discharge. The agonizing occipital headaches persisted for many weeks with lessening interval and with lessening severity.

About April 11, 1933, a small sensitive elevation appeared just below the supra-orbital ridge and half an inch temporal to the margin of the original wound. The slightest touch produced an excruciating occipital headache. Under local anesthesia an exploratory incision was made but owing to the extreme pain it was not fruitful of any information and was abandoned with the intention of using a general anesthetic the following day. Owing to a sudden illness of the reporter the patient was not again observed until June 2, 1933, about six months after the original injury. The small sensitive elevation still being present, a second attempt to investi-

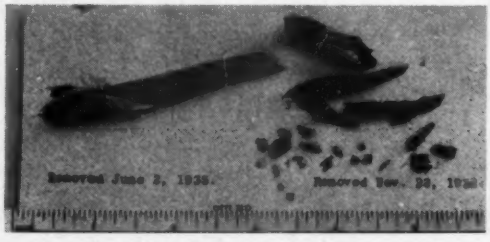

Fig. 2 (Harbridge). Wood particles removed from orbit.

gate under a local anesthetic proved fruitless owing to the intolerable occipital pain. A general anesthetic was administered and by careful dissection a foreign substance was encountered. The object was grasped by forceps which immediately slipped off carrying in its teeth fine splinters of wood. Thus being assured of the nature of the ob-

ject many unsuccessful attempts were made to remove it with various types of forceps. Finally a large pair of Kocher's forceps were applied and a good grasp secured following careful blunt dissection. By manipulation and with considerable force a huge piece of wood was drawn straight forward. The fragment of wood measured three and one-half inches in length and nine-sixteenths inch in diameter.

In order to trace the course and direction the piece of wood had taken the handle of a strabismus hook was inserted along the tract and an x-ray picture taken. As shown in the illustration the wood extended back three and three-fourths inches from the supra-orbital margin to a point half an inch anterior to the foramen magnum. In its course it had broken through the orbital plate of the lachrymal, ethmoid and a portion of the supra-orbital bone, passing through the ethmoid cells and lower portion of the sphenoid sinus and hugging the under surface of the sella, on to a point anterior to the foramen magnum. Its removal was not attended by any hemorrhage.

Comment: It is perfectly clear that the presence of this large piece of wood escaped detection at the time of the injury. This is explained by the fact that the small sensitive elevation did not present itself for three and one-half months after the injury. Also its location was removed half an inch temporal from the site of the original injury and was covered by uninjured skin. X-ray pictures were of no assistance. The reporter believes this oversight to have been providential, for if the wood had been removed at the time of injury, a severe uncontrollable hemorrhage would have followed thus seriously endangering life. Doubtless, the wood had become encysted thus affording protection against hemorrhage. The reader will recall that removal of foreign material was suspended twice due to uncontrolled hemorrhage and the wound packed. The wound healed kindly and at no time was there any infective discharge. At the present writing, fifteen months after the original injury and eight months after the removal of the large piece of wood the wound is firm and there are no local or general symptoms. The patient wears a prothesis perfectly, and has no difficulty with the tear duct or movement of the eyelids.

822 Professional Building.

SOCIETY PROCEEDINGS

Edited by Dr. H. Rommel Hildreth

MINNESOTA ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Section on Ophthalmology

March 23, 1934

Dr. F. E. Burch, presiding

Traumatic retinal detachment cured by diathermy

Dr. Sidney B. Russell (by invitation) reported the case of Mr. H. D. K., aged 42 years, who was first seen in the University Dispensary on July 8, 1933. He gave a history that in November, 1932, he was struck in the right eye by a flying piece of wood. There had been no pain and he had thought no more about it until six weeks later when he began to notice loss of vision in this eye.

When admitted to the dispensary the eyes appeared negative externally. Extraocular movements were normal. The right pupil was slightly larger than the left, round, but sluggish to light. The left eye was entirely normal, vision 20/13. The media were clear in both eyes. The right fundus showed white irregular broken streaks above the disc with a large disinsertion of the retina from about "8 to 12 o'clock," with detachment extending to obscure the macular area. Vision in the right eye was limited to perception of motion in the temporal quadrant. Tension was 35 mm. Operation was advised which he refused until September 29. Physical findings were the same on that date. He was put to bed on his right side with the foot of the bed elevated until operation was performed on October 5, 1933.

Thirty Safar and Walker pins were inserted around the disinsertion posterior to the ora serrata. The diathermy was applied to each point and with a single Walker applicator several additional scleral punctures were made to insure drainage of subretinal fluid. The patient was kept on his right side with the foot of the bed elevated for about three weeks.

On October 9th the cautery marks were clearly visible. The retina was in place except at the very upper margin. On October 28th the patient was allowed to be up. He could see light in all quadrants, and the tension was normal. There was still a small detachment superiorly. On November 4th vision in the right eye was 15/100 with the pupil dilated, left eye 20/13. The field of vision was normal in each eye.

In March, 1934, the vision was 15/100 in the right eye, 20/13 in the left. The retina was completely re-attached across the entire area of previous disinsertion, with marked pigment changes covering the area of fulguration. The retina was flattened. The media were clear. The tension was 24 mm.

Serous detachment of the retina occurring in eclampsia

Dr. C. W. Rucker (Minneapolis) reported the case of Mrs. V. R., aged 28 years, who was admitted to the obstetrical service of the University Hospital, November 16, 1932. She was in the eighth month of her third pregnancy. Five weeks before admission her physician noted rising blood pressure. Albuminuria occurred a week later, and then edema of the extremities. One week before admission she developed severe headache, epigastric pain and blurred vision. During the night prior to admission she had a severe eclamptic convulsion. For two days she had been blind except for the perception of light.

Examination revealed generalized anasarca involving the eyelids, hands and feet, and to some extent the body walls. Blood pressure was 256/154. The urine had a specific gravity of 1.032, was acid, contained 3+ albumin, many casts of all types, and a few red and white blood cells. Blood chemistry: carbon dioxide 37 percent, N.P.N. 28.5, and uric acid 3.07.

Fundus examination showed in each eye detachment of the entire lower half of the retina and a smaller detachment

in the upper temporal quadrant, with small hemorrhages and exudates in the macular region. During the first 26 hours the patient was given two doses of an ounce of magnesium sulphate by mouth, three injections of 10 c.c. of 25 percent solution of magnesium sulphate intravenously, one injection of 2 c.c. of 50 percent solution of magnesium sulphate subcutaneously and one injection of 10 c.c. of a calcium chloride solution intravenously. Then a Vorhees bag was inserted, and removed after 24 hours, followed two hours later by delivery of a dead 43 cm. fetus.

During these first two days the fluid output was less than the intake. On the third day 40 grams of urea by mouth produced a renal output of 2500 c.c. with an intake of 900 c.c. That evening 80 grams of urea were given by mouth and the next day, with an intake of 1000 c.c. of fluid, 3800 c.c. were excreted. That evening another 40 grams of urea were given, causing, on the following day, an excretion of 2500 c.c. on an intake of 800 c.c.

Thereafter the patient's condition improved rapidly. Her edema subsided and the blood pressure within ten days returned to normal and there was no albuminuria.

Six days after delivery there was no detachment in the upper quadrants of either eye, and less elevation (about 6 diopters) in the lower portion. The margins of the nerve heads were not blurred. The retinal vessels were narrowed. There were large white patches of exudate, principally in the nerve-fiber layer, some of which protruded into the vitreous, and near the left nerve-head a few streaked hemorrhages. Four days later there was no evidence of detachment in either eye. There were multiple patches of cotton-wool exudate on the temporal side of each optic nerve and around the macula, mostly in the nerve-fiber layer.

On January 6, 1933, when the patient returned to the dispensary for observation, the vision was 20/50 in each eye. On March 1st, vision was 20/30 in each eye; there were no hemorrhages and the areas of exudate were small and pigmented.

Retinal detachment; modern methods of successful treatment

Dr. F. E. Burch read a paper on this subject and presented a case of idiopathic retinal detachment during pregnancy, cured by Walker's endothermic technic. Mrs. D. R. J., aged 33 years, had been refracted yearly over a period of ten years. Her last refraction was O.D. —8.50 D.sph. ⌯ —1.00 cyl. ax. 150°, v. 20/30; O.S. —13.50 D.sph. ⌯ —2.00 cyl. ax. 15°, v. 20/50. There was a moderate myopic crescent in each eye with few choroidal changes and only moderate vitreous opacities; more in the left than in the right eye. On October 2, 1933, she reported and stated that vision in the left eye had become suddenly blurred following flashes of light dating back to September 10th. She believed the vision actually was impaired on September 15th. A retinal detachment involving the superior nasal quadrant was found and after two hours recumbency in the office, an oval tear was located in the "10 o'clock" meridian, along the superior nasal vessels, estimated at 5 mm. from the ora serrata. This patient was pregnant six months, but, excepting treatment for adenomatous goitre, she had never required medical attention since childhood. She was exceedingly apprehensive and nervous, bordering on hysteria.

Physical examination showed her a healthy, young primipara, 5 feet in height, weight 130 pounds, blood pressure 110/68, a trace of sugar in the urine. Blood examination showed hemoglobin 64 percent, W.B.C. 8,300, fasting blood sugar 71 mg. There was no renal impairment. Vision was 20/25 in the right eye and 20/50 in the left eye, with glasses. The temporal field was absent from the vertical meridian to the blind spot to the 45 meridian upward. For six days following admission to the hospital on October 4th she was given luminol, and atropin 2 percent and mercurchrome 2 percent were instilled daily in the left eye. She was lying on the right side with the foot of the bed elevated and both eyes occluded. The retina flattened out so that the retinal tear was readily seen upon each examination in the "10 or 10:30" meridian.

On October 10th a hypodermic of morphin and scopolamine was given in her room. Under pantocain locally, akinesia of the orbicularis and deep novocaine anesthesia, the sclera was fully exposed through a conjunctival incision 5 mm. parallel to the limbus exposing the entire superior nasal quadrant. The recti were not resected. Four traction sutures were placed in the conjunctiva and weighted over the patient's head. The meridian of the hole was located at "10:30 o'clock" and marked by gentian violet on each border of the limbus, and a traction suture inserted in the sclera at the "10:30" meridian. The sclera was carefully dried. By the use of the Safar technic, using the Rose Manufacturing Company's diathermy apparatus and Walker's needles, with 40 ma. current, twenty-one micro-punctures were made and the needles left in situ with threads attached. The area of the hole was completely surrounded and finally a puncture was made with the Ziegler knife permitting subretinal fluid to escape. The needles were then quickly withdrawn and some fluid could be seen to escape through the needle puncture. The operation was painless. Both eyes were bandaged and the patient placed in the same position previously described, which was maintained until adhesion was certain.

The eye was dressed and 4 percent atropin solution instilled after 48 hours, and daily thereafter. Healing was uneventful. Examination on October 17th showed definite localized patches of choroiditis around each micropuncture, with the retina entirely flat. On October 18th one could determine the previous hole in the retina and its underlying choroid, the hole being adherent at its margins. On October 22nd each choroiditic patch showed mild pigment changes, which increased gradually until the patient's discharge from the hospital four weeks following operation. The field of vision returned to normal for form and color. On March 23, 1934, vision with glasses was 20/40, somewhat better than she had at her previous measurement of the error of refraction.

Discussion. Dr. W. L. Benedict believed that in the operations by the older methods there was degeneration of the vitreous from the heat which accounted for some of the subsequent detachment after a temporary re-attachment. The diathermy method, using very much less heat and placing needles about the rent, seemed to provide more points of adhesion with less trauma. With the Lindner-Guist operation it was difficult to control reaction before neutralizing the caustic.

He said that most operators now believed it was not necessary to make exact measurements of the size of the tear and that if the barrage of contacts was placed about the tear, and particularly between the tear and the optic disc, a large percentage of successful results would be obtained. He felt that there was no question but what the insertion of the needles before applying the current was preferable to the use of the single needle. The success of the operation depended largely on whether the reaction occurred in the choroid, because applying heat to the sclera alone was not sufficient. Dr. Benedict believed, with Dr. Burch, that the equipment now provided by Walker was quite satisfactory.

W. E. Camp,
Secretary.

COLLEGE OF PHYSICIANS OF PHILADELPHIA

Section on Ophthalmology

March 16, 1933

Dr. Leighton F. Appleman, chairman

Fusion training in concomitant squint, with special reference to the amblyopia

Dr. H. Maxwell Langdon said that the modern treatment of a case of concomitant strabismus was divided into two parts, the correction of physiological defects and the anatomical disarrangements. Parents knew only about the latter, which they could see, but for the welfare of the child the functional disturbances were more important. Donders noted that convergent strabis-

mus in children usually had underlying hyperopia and he believed that this was a great factor in the production of the squint. Claude Worth agreed with Donders but believed that the condition of the fusion sense was the determining factor for the appearance or absence of squint. We frequently saw cases of high hypermetropia without squint but with a good fusion sense, and we also saw cases of much less hypermetropia with poor fusion sense and strabismus. In the great majority of unilateral cases the disuse of the deviating eye was apt to result in amblyopia from suppression of the image. Congenital amblyopia did occur but was rare.

A squinting child should be under observation as soon as the squint appeared; a deviating eye should have its function stimulated by occlusion of the preferred eye; glasses should be prescribed as soon as the child was old enough to wear them, not later than eighteen months old and the fusion sense should be trained with the stereoscope or the amblyoscope. The restoration of normal vision in an amblyopic eye was one of the most important things in the treatment of these cases and this must be begun early and completed by the time the child was about six years of age; after this age such treatment usually was unsatisfactory. The squint, if it did not disappear with this treatment, might be operated on at any time of the child's life, but after six years of age a good physiological result where there had been an amblyopic eye, was seldom obtained.

The orthoptic clinic of the Fifth Avenue Hospital

Dr. LeGrand H. Hardy (by invitation) said that the conviction that some children suffering from squint might be relieved of all their symptoms by orthoptic training and that many of them who required surgical treatment as well, would be more completely and permanently cured if the surgical treatment was supplemented by attempts to develop and integrate the function of the eyes led to the establishment of this clinic.

It was believed that functional training under the direction of a judicious surgeon who might operate when conditions were most propitious offered the greatest hope to thousands of afflicted patients and that as such it should be in the hands of the medical profession where it was least subject to abuses. It was a social misfortune that it had been exploited by those with neither the ability nor honesty to recognize its true worth and who by exaggerated, false and misleading claims had stigmatized the whole subject in the eyes of many honest surgeons.

The Clinic was modeled after that established at the Royal Westminster Ophthalmic Hospital by Miss Mary Maddox who had been exceedingly generous with aid and advice. It was established as a unit separate from the rest of the Eye Department. The patients were divided into three groups, one, under the direction of Miss Stark, who gave intensive, systematic training with the synoptophore; the other two groups were studied by staff ophthalmologists on alternate days. Regular attendance had been successfully encouraged by a variety of rewards, responsibilities and a definite program.

Discussion. Dr. J. Milton Griscom said that in each strabismus case our objective should be to secure normal vision, orthophoria, fusion capacity and stereoscopic vision. To attain this end we should consider carefully the various theories concerning the relation of squint and amblyopia, since at present no one theory fitted all cases. This had a direct bearing on treatment, since time and trouble might be saved if the proper line of attack were adopted. For instances, if we believed the amblyopia to be due to the squint, we would operate early, regardless of the degree of deviation; if we believed the squint to be the result of unequal vision in the two eyes or to a congenial amblyopia, we should give amblyopic and fusion training in those patients whose squint was 25 degrees or less, and operate only when the squint was high in degree or the training failed. In other words, it was possible to develop a rational line of treatment in each case according to the symptoms presented.

Dr. Luther C. Peter said that a central scotoma and amblyopia exanopsia were of prime importance. The central scotoma was a relative one of about two or three degrees in diameter. It was best uncovered by a special equipment on the Ferree-Rand perimeter. He had had a special tangent screen made, in which the central opening was little more than a pinhole. A light was placed at the back of the instrument, which shone through the opening, and upon which the patient fixed his gaze. The light penetrated the central scotoma if it was an acquired scotoma. Little difficulty was experienced in outlining this small relative blind spot.

It was an important and yet an easy matter to differentiate between amblyopia ex anopsia and congenital amblyopia. The essential difference lay in the size and contour of the blind spot. In most instances, the amblyopia found in monocular squint was the acquired variety, and when training was begun sufficiently early, i.e., before the end of the sixth year, in a majority of instances normal vision could be restored by proper methods. Each year, however, after the seventh added increasing difficulties to bringing back vision to normal. He had been able to restore vision in patients up to nineteen and twenty years of age. It was probable that beyond this age it would be exceedingly difficult to bring vision up to normal. In fact, in adults, when it was possible to bring vision up from 6/30 or 6/22 to 6/12, it was probable that the vision was slightly extramacular and that the scotoma was still present.

The synoptophore, in his experience, was one of the best adjuncts to the work in training for squint. It was pliable in its application, and could be used for training in the various stages of amblyopia and in fusion. It was especially useful in bringing about fixation in cases of profound amblyopia. Here the flashing device was of great value. Of even greater value, however, was the revolving type of stabilizer, in which the same flashing method could be used by a rotating colored disc, which could be rhythmically flashed and followed. Unfortunately this device was not in the hands of many oculists, but rather in the hands of those who were less qualified, and who used it for commercial purposes. For awakening fixation in profound amblyopia, as well as in many other phases of squint, he found it excellent.

He said that Dr. Hardy had called attention to the great difference between the symptoms of true alternating squint and those of the monocular type. It was possible to convert a monocular type into an alternating squint, but one should always remember that originally this latter type belonged to the true alternating group.

Dr. Peter referred to the possibility of developing fusion at any time of life. Just recently he had operated on a man, 43 years of age, who had suffered from paralysis of the left superior rectus and overaction of the right inferior oblique from childhood. On the third day after a tenotomy of the right inferior oblique and a tucking of the left superior rectus, the patient developed, for the first time, single binocular vision, and in a few days was able to fuse any cards in the stereoscope, and developed full streopsis. This was only a single illustration of many in his experience, in which fusion could be developed at almost any time of life.

A. G. Fewell,
Recorder.

COLLEGE OF PHYSICIANS OF PHILADELPHIA

Section on Ophthalmology

April 20, 1933

Dr. Leighton F. Appleman, chairman

Paralysis of the superior oblique following frontal sinus operation, corrected by recession of the inferior rectus on the opposite side

Dr. C. E. G. Shannon said that the patient, aged 42 years, was seen on October 4, 1932, complaining of vertical diplopia which had existed for six months. The history was as follows: In January, 1932, the patient suffered from a severe attack of influenza with involvement of the right frontal sinus. A modified Killian operation was per-

formed for drainage of the sinus. Two weeks after operation, diplopia developed, gradually increasing in degree.

Examination revealed a paralysis of the right superior oblique muscle, due no doubt to the operative interference on the sinus. A recession of the corresponding yoke muscle, the left inferior rectus, was done. On the following day, examination showed that the diplopia had completely disappeared and it had remained so for over one and one half years.

Diplopia, following Killian operations, was unusual. Dr. Zentmayer reported three similar cases in 1926. A tenotomy of the left superior rectus was performed in all three cases. Manthner had previously recommended this procedure. Landolt, however, preferred advancement in all musculer anomalies. Bannister, 1928, followed Landolt's advice but attacked the muscles on the same side. Dr. Shumway reported a similar case in which a tenotomy was performed on the corresponding yoke muscle. Suker, 1931, treated his case of paralysis of the left superior oblique by splitting the homolateral external rectus and inferior rectus muscles in half and after nicking the sclera for about 4 mm. between the insertion of the external and inferior recti muscles, he attached the lower half of the extrenus and the temporal half of the inferior rectus at this point. His result was satisfactory.

With the deep attachments of the oblique, any operative procedure on this muscle was out of the question. The corresponding yoke muscle must be attacked. While tenotomy of the yoke muscle had proven satisfactory in many of these cases, the introduction of the recession operation on a yoke muscle offered a more scientific and effective method of correcting muscular paralysis.

Disussion. Dr. Shumway said that Dr. Shannon had referred to a case which he had reported in 1921, before the Pennsylvania State Medical Society, Section on Ophthalmology. This was a case of fracture of the parietal region of the skull on the right side, with paralysis of the left superior oblique and a hyperphoria of 23 degrees. Nine months were allowed to elapse before attempting to correct the diplopia. It was important to allow full time to elapse before operating in these cases, because sometimes in cases due to brain injury, they would recover without operation. In many cases, however, due to local injury, sinus operation or foreign body striking in that part of the orbit, and severing the muscle tendon, operation was necessary at once.

In 1864, Albrecht von Graefe discussed operative procedures, and his advice had not been improved on, and was followed in Alfred von Graefe's article in Graefe-Saemisch. He discussed the question very thoroughly in his article in 1921, especially the muscles which might be operated on to relieve the diplopia. In paralysis of the superior oblique, it was best to perform tenotomy of the inferior rectus of the other eye. It was possible to advance the inferior rectus of the same eye, but this might increase the esophoria which was usually present.

French surgeons, especially Landolt, objected to tenotomy in these cases and advised advancement of the inferior rectus of the same eye. Tenotomy was a simpler operation, but there was a possibility of getting an over effect. In his own case there was a residual hyperphoria, which disappeared gradually and the man went back to his work as a skilled mechanic, without difficulty.

Dr. Zentmayer said that tenotomy of the inferior rectus of the left eye for paralysis of the superior oblique of the opposite eye was the logical procedure in this case. It was possible, however, to obtain an overcorrection as illustrated in one of his own cases in which it was necessary to perform several other operations before the desired result was achieved.

Ocular manifestations in a series of fibroblastomata

Dr. T. B. Holloway read a paper on this subject which was published in the Amer. Jour. Ophth., 1934, v. 17, June, p. 475.

Discussion. Dr. Charles Frazier said that he had reviewed at considerable

length their experiences with between seventy and eighty fibroblastomata of the cerebral hemispheres and had discussed the symptomatology from every angle except that of the visual apparatus (Arch. of Neuro. and Psych., 1933, v. 29, May, p. 935). He would not refer in this discussion, therefore, to such comments as Dr. Holloway had made on the origin, the pathology or the focal symptoms of the fibroblastomata but would confine such comments as he might have to make to the effect of the tumor upon vision and upon the visual apparatus. By way of preface he wished to emphasize the desirability of discussing the findings with relation to the site of the tumor.

Speaking first of the ocular findings in frontal lobe tumors, in twenty-two cases there was failing vision in twelve, papilledema in fourteen, visual hallucinations in one, exophthalmos in four, nystagmus in three, and corneal anesthesia in three.

Visual hallucinations in frontal lobe tumors were not common: in fact, he knew of no previously published reports of such. They were found usually in parts of the brain through which the optic pathways ran and were associated with visual field cuts. Their occurrence in a frontal lobe tumor in a non-psychotic individual was both interesting and important, indicating as it did that they might occur in areas unassociated directly with the optic nerve paths.

As to the fields, he was impressed with Dr. Holloway's report in which he recorded no hemianopsia and eight instances of concentric contraction of the fields. In the larger number of cases of frontal lobe tumor upon which his figures were based, there were three cases in which there were field cuts; one a bitemporal, one an homonymous hemianopsia, and one a cut in one temporal field. As to the relative value of the red and white fields, Dr. Wentworth, of Dr. Holloway's staff, who made all the perimetric examinations, had told him that contrary to the opinion of others, she was quite convinced that she had been able to find field cuts for red before she had been able to detect them with white.

The fact that in the presence of an exophthalmos the prominent eye was homolateral to the lesion was a matter of great practical importance, for with the exception of the right temporal lobe we had more difficulty in determining laterality in frontal lobe tumors than in any of the other lobes.

He was in entire accord with Dr. Holloway's findings with regard to visual perception in that the greater impairment was homolateral. Judging from his own experience, the Gowers-Paton-Kennedy syndrome had been given much more attention than it deserved, as a localizing phenomenon. Whatever the mechanism might be, and Dr. Holloway had expressed his personal views, there was, in these seventy-odd fibroblastomata, only one case of this syndrome and that in a temporal and not a frontal lobe tumor. In a case of frontal lobe tumor operated on by Dr. Grant in his clinic the other day, the findings were quite the reverse of what Gowers described. There were five diopters of choking on the side of the tumor and a contralateral optic atrophy. Had it not been for the ventriculogram, the exploration would have been made on the wrong side.

When considering fibroblastomata of the precentral gyri one was not so dependent upon the eye phenomena since in every one of them there was unilateral weakness of varying degree. In this series there were only three cases of papilledema and three of failing vision, a very much lower incidence of both than in the frontal lobe series. In the former the incidence was about one to five and in the latter about one to two. Obviously in tumors of the precentral gyri motor phenomena and convulsions were the predominant symptoms.

Ocular findings played little part either in the diagnosis or localization of parietal lobe fibroblastomata of which he had in his series eight cases. The ease with which correct localization was made was evident from the fact that in only one case was it necessary to make a ventriculogram. There were three instances of choked disc and but one of failing vision.

In the localization of tumors of the

temporal and occipital lobes, the neurosurgeon was always hopeful that the site of the tumor would be determined by an homonymous quadranopia or hemianopsia. In his series of eighteen temporal lobe tumors there were, as Dr. Holloway had indicated, only seven instances of homonymous hemianopsia. Unfortunately, and this was particularly true of tumors of the right temporal lobe, this localizing symptom did not occur with anything like uniformity. In some cases this might be the only localizing sign and in others even when present one might have a reasonable doubt as to whether one was dealing with a tumor of the temporal or occipital lobe. As Dr. Holloway had pointed out, a superior quadranopsia suggested a temporal rather than an occipital location, but in none of his cases was this field defect observed. The detection of this phenomenon no doubt implied an earlier phase in the development of the growth. In this connection it must be remembered that we were dealing only with fibroblastomata, tumors essentially slow in growth, and it was quite readily understood why his patients were not seen until the tumor had been present for a long while.

But there were instances of temporal lobe tumors when the quadranopia involved the inferior rather than the superior quadrant as in a series recently reported by Schlesinger (Arch. of Neurology and Psychiatry, 1933, 29:4, 843).

The distinguishing feature between occipital and temporal lobe tumors to which Horrax called our attention, the preservation of central vision, was helpful but by no means constant. In six temporal lobe tumors recorded by Schlesinger, the macula was spared. On the other hand, our statistics bore out Horrax's contribution in so far as that when central vision was spared the tumor was more apt to be in the occipital than in the temporal lobe.

Just why central vision was preserved in occipital lobe tumors was a matter of speculation. A probable explanation, according to Spiller, was that central vision had a very large representation in the calcarine cortex because of its importance. This was in accordance with the general principle that those portions of the body, the function of which was of great importance (e.g. the face which included the muscles of speech), had a much larger representation in the brain cortex than those of less importance. The mechanism of speech and singing required a large cortical representation and the facial center extended well up on the lateral portion of the cerebral hemisphere. In the same way, central vision was a most important part of all vision and was believed to have a large representation in the calcarine cortex. Because of this, the destruction of the greater part of the calcarine cortex was necessary for loss of central vision.

He said that we were still more or less uncertain as to the physics of choking. We presumed an interruption of the venous circulation and it might be that the temporal lobe tumor, by virtue of its location might make more pressure on important venous channels such as the cavernous and straight sinuses.

When referring to the effect of pressure in the making of a papilledema, he would like to refer to the question of inequality of disc elevation. Personally, he had attached little importance to this finding as indicating laterality. Presumably the greater choking was on the side of the tumor: Paton (Brain, 1909, 32:65), found in only fifty-two percent was the greater choking homolateral, but it was significant that he found homolaterally greater choking in temporal lobe tumors.

With regard to this inequality, he had two statements to make, the first that the large majority were observed in the frontal lobe tumors, and of these homolateral to contralateral was in the proportion of four to one. It was questionable whether we could accept the explanation of Gibbs (Arch. Neurology and Psychiatry, 1932, vol. 27, April, p. 828) that the variation between the two sides was due to the position of the tumor with relation to the large venous channels.

A. G. Fewell,
Recorder.

CHICAGO OPHTHALMOLOGICAL SOCIETY

March 19, 1934

Dr. Dwight C. Orcutt, president

Macular degeneration

Dr. Hallard Beard presented a woman whose vision in the right eye was 0.1, the left eye 18/200, not improved by glasses. Vision had been failing gradually for about two years in the right eye, and for about six months in the left eye. Externally the eyes were normal and the discs were negative. In the macular region of each fundus was a clearly defined lesion about four times the diameter of the disc, lighter colored than the surrounding fundus, of a mottled yellowish appearance. It was definitely elevated when viewed through the Gullstrand binocular ophthalmoscope. The surface of the plaque was covered with somewhat irregular vessels which appeared to be derived from the retinal vessels. The diagnosis was Kuhnt-Junius macular degeneration, an entity which was becoming more common as we learned to look for it, occurring in older people, usually with a moderate degree of arteriosclerosis. When these cases were studied anatomically there was much evidence of a vascular origin for the lesions themselves. There appeared to be a heaping up of connective tissue and glial tissue over the level of the retina in whorls which appeared to be centered about the retinal vessels in this neighborhood. Vision in this area was reduced to nearly zero, and grossly the lesion was that of a fibrous pancake arising from the connective tissue of the vessels and overlying the retina in the central region.

Discussion. Dr. Dewey Katz called attention to the small area of circinate retinitis in the right fundus. Areas of circinate retinitis were present in several of the cases described in the original publication of Kuhnt-Junius.

Bilateral choked disc

Dr. Philip O'Connor presented a man who had come to the Infirmary last August; his complaint was loss of vision in the right eye, starting two months before. The family history was negative. The past history was negative except that he had had a chancre in 1925 for which he was under treatment for a year and a half. Since that time several blood Wassermann tests had been negative. External examination of the eye was negative; the pupils were equal and reacted to light and accommodation. Vision in the left eye was less than 5/200; in the right eye 20/50, not improved with lenses. Examination for fields and blind spots in the right eye was unsatisfactory; in the left eye the fields were normal, the blind spot was enlarged. There was bilateral papilledema of more than 4.5 diopters. No physical cause could be found to explain the swelling of the discs and laboratory tests were negative.

Discussion. Dr. Percival Bailey said that when the spinal fluid pressure was elevated a decompression should be performed whether lues was present or not. In his experience antiluetic treatment following trephining was very effective. He had seen cases in which choking of the optic disc subsided after treatment, but this occurred also in tumors. Choking of the disc, even when luetic, would subside much more rapidly if the skull was decompressed.

He protested against the idea of waiting until the visual field began to narrow. In his experience, even though the pressure was relieved, the optic atrophy increased. If a decompression was to be done it should be done as early as one could diagnose increased pressure, not waiting until the visual field diminished.

Dr. Hallard Beard raised the question whether blindness was due to choking or to local pressure back in the chiasm. Choked disc alone would not cause blindness for it might exist for two or three years without loss of vision. Decompression would be untimely unless it had been shown that no other method was likely to relieve the cause of increased intracranial pressure. In the Vienna clinics they waited until the visual field had begun to contract perceptibly before a decompression operation. The early blindness in the right eye should help to localize the presence of

the tumor in the neighborhood of the right side of the chiasm.

Contraction of the visual fields did not imply optic atrophy. It might represent a functional loss at first, and as this change was very gradual, he thought there was no great hurry about decompression.

The nature of photophobia

Dr. James E. Lebensohn said that in current usage, "photophobia" was applied to two quite different sensations, true photophobia, the ocular pain induced by exposure to light; and the uncomfortable vision of dazzling.

That true photophobia could not occur without the functional integrity of the optic and trigeminal nerves had been clearly established. Light, however, could effect painful sensation only through the agency of photomotor activity, vasomotor changes, or metabolic processes, but there was definite physiological evidence solely for photomotor phenomena.

Both corneal and iridic photophobia were of the same nature; the connecting link between them was the trigeminal pupillary reflex. The vasodilatation induced by this reflex was the sensitizing factor that made the normal pupillary reaction a painful response. This vasodilatation was as essential to the exhibition of photophobia as the three other factors, vision, oculomotor function and sensation.

The role of vasodilatation was demonstrated by the following observations. Vasodilatation produced by the removal of the superior cervical ganglion, or the instillation of histamin in the anesthetized eye induced photophobia. Relief from photophobia was occasioned by adrenalin; in chronic conjunctivitis, simply by instillation; in corneal and iridic cases by subconjunctival injection.

The ciliary spasm, resistant to atropin, so often found in inflamed eyes was probably an example of contracture induced by vasodilator substances. The irritable ciliary muscle responded to light, whereas ordinarily it was not thus affected. In photophobic eyes the turning on of a powerful light nearby promptly induced one quarter to one diopter of myopia.

The use of adrenalin in chronic conjunctivitis to control photophobia had therefore a rational indication. Tinted glasses were to be avoided, but when indicated, relief was to be expected from only the darkest shades. In corneal and iridic cases, when cycloplegics did not give complete relief, sedatives that tended to reduce trigeminal irritability should be of help. In stubborn cases, the occasional instillation of concentrated adrenalin solutions was advised.

Discussion. Dr. E. V. L. Brown said that a tuberculous young woman of 18 years was seen at Billings Hospital some five or six weeks ago with a marked bilateral violaceous injection of each eye and a severe photophobia of two or three weeks duration. About two months previous she had been given a series of gold injections for the pulmonary tuberculosis. A single drop of atropin permanently relieved the injection and photophobia. He thought this observation was quite in line with what Dr. Lebensohn had given.

Dr. J. E. Lebensohn (closing) said that he was interested in determining whether lid spasm affected the tension in photophobia and took tonometric readings of a number of affected eyes under dim and strong illumination. It was difficult to do this under these conditions, yet it was his impression that there was no significant change in tension with or without the additional light. Undoubtedly with erosion of the cornea, foreign body, or corneal disease, the sensation of contact with the lids tended to make the trigeminal nerve hyper-irritable. Since the cornea was so richly supplied with nerves, and fibers from the subepithelial plexus reached almost to the surface, it did not require much irritation to stimulate the nerve endings.

Studies in protein content of human aqueous

Dr. Elias Selinger read a paper on this subject which will be published in this Journal.

Discussion. Dr. William F. Moncreiff said that these studies of the aqueous

as described by the essayist found a parallel in the studies of the spinal fluid in diseases of the central nervous system, and certainly did not involve greater difficulty or complexity. The anterior chamber puncture, in the hands of the capable ophthalmologist, was certainly as safe and as simple as the lumbar puncture in the hands of the neurologist; and where was the neurologist who would willingly dispense with the examination of the cerebrospinal fluid?

Dr. Michael Goldenburg said that the practical application of capillary permeability had been of interest for many years. Krogh's work on the anatomy and physiology of capillaries and later experimental reports were now well known. To Schaly of Arnheim belonged the credit for demonstrating in the tissues of the eye of the human being the presence of the Rouget cells which influenced capillary permeability. It had of late been demonstrated that the endothelium was also a factor in this function. The capillary wall was permeable to crystaloids in solution and impermeable to colloids, but experimentally by strong stimulation the capillaries became widely dilated, permitting even the colloids to pass through. He suggested that the essayist check his findings with the cantharides blister tests for protein content as demonstrated by Patersen and Levinson. They had reported on a very large series of cases in normal and abnormal states. Deductions might be possible so as to avoid the anterior chamber puncture which was not without some danger.

Dr. Elias Selinger (closing) said that protein determinations had been done for many years before Magitot did his work. They were done quite accurately by Wessely and others a number of years before. As to comparing the protein content of a blister produced on the skin with the protein content of the aqueous, that would apparently be of little value. A marked increase was evident by the slitlamp and other methods, but a slight increase was not so easily noted. A blister of the skin would probably have enough protein to give an opacity beyond the upper limit of the scale mentioned. So far as the danger of introducing infection into the eye was concerned, if the aspiration was carried out under aseptic conditions the danger was practically nil. Magitot in 1925 reported 326 anterior chamber punctures without a mishap. As to Dr. Folk's question, the case of heterochromia irides turned out to be a case of bilateral chronic uveitis. No infection was introduced by the anterior chamber puncture. It was necessary to look very carefully a number of times before a slight increase in cells in the aqueous was found, three or four weeks after the puncture had been performed.

Histopathology of coloboma of choroid and optic nerve center

Dr. M. L. Folk read a paper on this subject which will be published in this Journal.

Discussion. Dr. O. B. Nugent stated that in the study of these cases it was a notable fact that the pigment epithelium of the retina was not present. The neural tissue or inner layer seemed to be present in some cases. One could scarcely imagine the formation of the retina without the pigment epithelium being formed at the same time. Therefore, when this pigment epithelium did not receive nourishment the pigment migrated if there was any pigment there, and the epithelium changed into a fibrous tissue. This might explain the fibrous tissue found in the coloboma, and also the apparent absence of the outer layer of the retina. The old theory of interference with formation of the crypt by mesodermic tissue was certainly going to be hard to break down by any other type of theory.

Dr. M. L. Folk (closing) in reply to Dr. Nugent, said that the absence of pigment epithelium was probably responsible for the formation of the coloboma of the choroid, according to Miss Ida Mann, but the retina could be formed even in the absence of the pigment epithelium.

Robert von der Heydt.

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PROFESSIONAL PUBLICITY

On the first of November, 1850, Albrecht Graefe opened his polyclinic in Berlin. He did not need money, but wished to develop a practice. For two years he had been wandering abroad from clinic to clinic, working under such men as Arlt, Desmarres, Sichel, and the two Jaegers. He was a pioneer in ophthalmology, for the ophthalmoscope had just been invented and Graefe was its ardent propagandist.

In order that his light might not remain "hidden under a bushel," Graefe not only rented private consultation rooms, but in another house opened a polyclinic; and in Berlin newspapers there appeared daily an announcement that needy patients would be treated without compensation.

In earlier days the publicity methods of the best surgeons often faintly echoed those of some famous irregulars. You know the style! "Mr. So-and-So, Oculist Extraordinary to His Majesty ——, to Her Grace the Duchess of ——, and so on, "having returned from two years of unrivaled success in foreign countries, begs to announce," and so on. The style of the regular was of course less bombastic, but it sometimes blew the advertiser's own horn quite vigorously. Graefe's methods of publicity were extremely genteel compared with those of some predecessors in the regular profession.

In Europe the maintenance of private charity clinics, and even public announcement of the fact, are still much commoner than in the United States. The purpose of such institutions is very seldom entirely altruistic. Sometimes even more than public hospital appointments, the private clinic not only furnishes experience, but acquires reputation which is remunerative among the better class of patients.

In discussions of the medical code of ethics, the genuine idealism of a really noble profession is rather inextricably mixed with a good deal of cant and hypocrisy. Not cynicism, but a frank recognition of the facts of human nature and economic necessity, might re-

gretfully question the literal truth of the statement that "a profession has for its prime object the service it can render to humanity." This is indeed the ideal to be aimed at, and the best representatives of the cult of Esculapius go far toward realization of the ideal; but can we truthfully say more than this?

Under "Advertising," the "Principles of Medical Ethics" of the American Medical Association declare it "unprofessional to procure patients by indirection . . . or by indirect advertisement, or by furnishing or inspiring newspaper or magazine comments concerning cases in which the physician has been or is concerned. All other like self-laudations defy the traditions and lower the tone of any profession and so are intolerable. . . . It is unprofessional . . . to employ any methods to gain the attention of the public for the purpose of obtaining patients."

It we are prepared to look facts squarely in the face, analysis must demonstrate that many successful practitioners, generally admitted to be of the finest type, resort to several methods for keeping themselves directly or indirectly in the public eye. Who will insist that the majority of medical papers, even of the better sort, are written out of a purely altruistic desire to make knowledge grow from more to more; or that most medical addresses before public gatherings would be undertaken without the incentive of enhanced lay familiarity with the speaker's professional standing? The majority of efforts in the direction of so-called research, outside of institutions especially existing for that purpose, are at least largely due to the prospect that they may increase the reputation of the research worker among his fellow practitioners, and hence often, indirectly, among the general public. In the same category might be listed much of the gratuitous work done in public institutions.

It would be difficult or impossible to carry to its logical conclusion the provision as to methods for gaining the attention of the public for the purpose of obtaining patients. But perhaps our really hardworking and for the most part conscientious boards of censors have expended more ineffectual time and effort against the inspiring of newspaper or magazine comments than in any other line of endeavor.

In our modern life one of the greatest tyrannies is constituted by the public press. In the eye of the newspaper editor or reporter nothing is private, nothing devoid of interest to the reader who makes advertising profits possible. If eye surgeon X has done a glaucoma operation on His Excellency the Crown Prince of Titipu, the facts, and much that is not fact, must be noised abroad through the syndicated news column. Or if Dr. B has just returned from a study of trachoma and the steps for its eradication among the South Sea Islanders, Dr. B must be met at the dock, and must be asked to state the number of patients he has treated, to describe his own surgical technic, and to announce how soon he will apply this newly acquired knowledge to the treatment of his fellow citizens. After the discovery that his old college friend is now a newspaper reporter, Dr. B's enthusiasm for conversation may wane. But too late! His request for silence is denied or ignored, and from some dark corner a youthful photograph is secured for reproduction in the newspaper column. Presently, jealous colleagues get busy, and soon Dr. B must appear on the censorial carpet.

The problem is complicated by the fact that the medical profession as a whole really desires to educate the public in medical matters, and it is often difficult to know just how far one should go in this process of lay education, and how soon explanations of medical fact and experience cease to be altruistic and become self-laudation or indirect advertisement.

Sometimes the professional jealousies and spites of the particular community play a large part in determining whether indiscretions as to newspaper publicity are simply smiled at or are frowned upon to the extent of excluding the offender from important professional organizations. In our downright burst of rigid righteousness we can admit no excuse, while on another occasion it may be quite easy to concede that a couple of columns of professional biography are due to the excessive en-

thusiasm of a patient who has become a lifelong friend.

The necessity for avoidance of self-laudation or self-advertisement arises from the danger that medical men may sink to the level of the charlatan who cries his wares against a rival in the public market. Here and there it is necessary to treat most severely some gross breach of the ethical code as to advertising or publicity. More frequently it is sufficient to call the attention of the supposed offender to the absolute need for unrelenting vigilance against the wiles of the public press, and especially to the need for the most rigid possible interpretation of the rule that it is unprofessional to procure patients, even by indirection, through solicitors or agents of any kind.

"The most worthy and effective advertisement possible . . . is the establishment of a well merited reputation for professional ability and fidelity, . . . the outcome of character and conduct."

W. H. Crisp.

DANGEROUS HYPNOTICS

The doctor of medicine is supposed to know enough about medicine, to prescribe drugs and to understand poisons. He may restrict his practice, and think of himself only as an ophthalmic surgeon, or as a medical refractionist, but this does not relieve him from moral and legal responsibilities that come upon him with the degree of M.D. He can refuse to treat a patient, but when he undertakes to treat one, he must be prepared to use the care and skill, and possess the knowledge commonly expected of physicians at the present time. He is expected to know the therapeutic and toxic effects of every drug he prescribes, and he cannot learn them from the talk, or literature, of the drug salesman, who induces him to try a new preparation.

In 1869 chloral hydrate was introduced as a hypnotic and anesthetic. It was found to be a powerful hypnotic, and came to be widely used by the medical profession, and by self-prescribers who feared insomnia. Some patients took as much as 300 grains daily, without alarming symptoms, or apparent harm. It was proclaimed as free from the dangers of opium and its derivatives. Later it was reported to have caused death by a single dose of 15, or of 10 grains. It was found to be an insidious, habit-forming, dangerous drug, and was often used for suicide. At one time it was estimated (U. S. Dispensatory 21st. Ed) that one ton of chloral was used daily in Great Britain and America. Its use rapidly declined. In the last volume of the Cumulative Index Medicus there are two references to Chloral, and forty-five to Barbital and its derivatives.

In The Lancet there has recently been a discussion of the dangers from Barbital, and an article in the Lancet for March 10th, by Sir James Purves-Stewart and Sir William Willcox, on Coma from Barbitone Poisoning, mentions twenty-five names, many copyrighted, proprietary names, under which the chief members of the barbituric acid group are being prescribed and sold to the people. They give the average, minimum fatal dose for veronal as about 50 grains; although an amount as small as 10 grains has been known to cause death. They report two cases of acute veronal poisoning, in which life was saved by cisternal puncture, after much larger doses.

A lady of 40 years took 75 grains of sodium hebaral and became comatose. Her medical adviser promptly washed out her stomach, performed colonic lavage, and gave the usual antidotes. Fourteen hours after taking the drug, the authors of the paper were called to see her in consultation. She was still deeply comatose, with moderately contracted pupils reacting to light, absent corneal reflexes, and other evidences of barbitone poisoning. By cisternal puncture 16 c.c. of cerebrospinal fluid were withdrawn. At 22 hours the puncture was repeated and 14 c.c. of fluid withdrawn. At 25 hours she awoke, and at 28 hours she was "mentally clear and chatting freely."

A lady of 30 years "swallowed 48 grains of luminal together with 30 grains of soneryl, making a total of 78 grains of barbitone compounds." After 7 hours she was still deeply comatose. Her stomach and colon were washed

out, hot coffee and strychnia given. At ten hours 11 c.c. of cerebrospinal fluid were withdrawn by lumbar puncture. At eleven hours there was no improvement, and 22 c.c. of fluid were withdrawn, by cisternal puncture. Coma continued until, after 14 hours, a second cisternal puncture drew off 14 c.c. of fluid. At 24 hours she began to make voluntary movements, and at 34 hours was mentally alert and moving all her limbs. This patient took the dose with suicidal intent, and thirteen days afterward took 100 grains of luminal. She was treated with lumbar puncture and four cisternal punctures, withdrawing in the aggregate 101 c.c. of fluid, in 33 hours. On the third day she began to talk, but showed mental confusion for another week. Tests in these cases showed barbituric acid compounds, in the urine and cerebrospinal fluid, diminishing before improvements in the general symptoms occurred.

These writers offer no objection to use of barbituric acid drugs, under medical supervision. But they point out that daily repetition, in hypnotic doses, is not free from danger, and frequently induces addiction. Persons taking a single dose may become confused, and continue repeating it with a fatal result. Barbituric acid compounds should only be obtainable on medical prescription, not to be repeated without written authority. The paper was written to show the value of cisternal puncture for acute barbitone coma. The eye physician sometimes prescribes a hypnotic, and patients with eye strain often complain of headache, insomnia and other symptoms, of neuropathic origin. It is important to bear in mind the danger and symptoms of poisoning by barbitone compounds that are urged upon us under various copyrighted names.

Edward Jackson.

PHOTOGRAPHY AND OPHTHALMOLOGY

An article in the June issue of this Journal by Pierce, concerning case-history photographs with the miniature camera, leads to a consideration of the part that photography has played in the recent advance of ophthalmology.

Such specialized apparatus as the Nordenson camera for fundus photography, as manufactured by Carl Zeiss, is not at the command of everyone, but for those who can avail themselves of this equipment there is no better method of keeping a record of fundus changes and their progress. This is admirably illustrated by Bedell in his excellent atlas of fundus photographs. If many of the critics of this form of record would take the time to learn the proper interpretation of a fundus photograph, just as one does of an X-ray plate, they would become less critical and find it most valuable.

The firm of Zeiss also manufactures a stereoscopic camera for making photographs of the anterior portion of the eye. This one purpose is thus very well accomplished, but this camera is a fairly expensive piece of apparatus and is adaptable to no other types of photography.

For many of us who wish to keep case-history photographs of the entire head of the patient, such as before and after strabismus operation, "close-up" photographs of the eye for lesions of the anterior segment, and photographic records of pathological material, the article of Pierce will be an introduction into the field of usefulness of the miniature camera in ophthalmology.

While many of the miniature cameras will suffice for case records, there are two outstanding models on the market which are particularly valuable to the ophthalmologist. These are the Leica, manufactured by Leitz and described by Pierce, and the Contax made by Zeiss and used by the writer. Even when equipped with a very fast lens these cameras represent an investment less than that required for the stereo camera which is used for the anterior segment exclusively. Thirty-six negatives can be made on one roll of film at a cost of about fifty cents. Although the negatives are quite small (1 × 1½ inches), they stand enlargement to almost any size if the modern fine grained emulsion is used.

With such a miniature camera and a fast lens (Sonnar F 2), the tripod ar-

rangement as used by Pierce is not even essential, because with photoflood lamps which produce adequate illumination, snapshots may be made while holding the camera in the hand. When the office is once equipped with proper illumination, this type of camera serves for taking photographs of the entire head of the patient or "close-ups" of the eye where more magnification is desired. By the use of a copying stand, photographs of tumors, gross specimens, and even of microscopic slides may be made in natural size. Furthermore, photographs from textbooks or drawings are made with very little effort with this attachment.

If it is desirable to use such photographs for teaching or lecture purposes, a positive strip of film may be printed at a cost of about five cents per print and projected directly on the screen. This saves the necessity and expense of lantern slides, and it is much more convenient to carry a small roll of film as compared with heavy and bulky lantern slides.

If further justification of the expense of such photographic equipment is needed, the miniature camera may be considered as a sort of recreation as well as a part of the office equipment. It has the advantage of ready portability and will make photographs of almost any type as well or better than most of the cameras now in use. Anyone would be delighted with the enlargements obtained from these small negatives.

A variety of extra attachments are made for these cameras for those who become interested in other phases of photographic work as, for example, color photography.

A properly made photograph tells more at a glance than a lengthy description, and a collection of such records of suitably selected cases from the practice of any ophthalmologist will be of inestimable value to those who are to follow in our profession. The miniature camera is not a new idea, but has been developed practically to a state of perfection in recent years. It is to be hoped that this form of photography will be investigated by those who have heretofore considered it too bothersome or too expensive to keep photographic case records of their most interesting material.

M. F. Weymann.

BOOK NOTICES

Diseases of the eye. By Sir John Herbert Parsons. 695 pages. 21 colored plates and 353 text figures. The Macmillan Company, New York. 1934. $5.50.

The seventh edition of this very valuable text book succeeds the sixth edition published in 1930 and 1931. No radical changes are noted. The same number of plates are used and five more text figures are introduced. There is about the same amount of printed material. The chapter on physiology has been rewritten. This book is of convenient size and contains an amazing amount of material. No better text book for the student exists.

Lawrence T. Post.

Ocular dioptrics and lenses. By G. F. Alexander. 216 pages, freely illustrated by optical diagrams. Companion volume to Ophthalmoscopy and Photoskiascopy. William Wood and Company, Baltimore: printed in Great Britain. Price $4.75.

In the main this book deals with its subject by the use of mathematical formulae which are little understood by the average practicing ophthalmologist. The subject seems to be well presented but certainly is not for the beginner in refraction.

The chapters on accommodation and its anomalies contain the views of the author, based on many of his own observations. He acknowledges that there are those who do not agree with much that he has to say. His ideas are most interesting.

Many practical points for the prescribing of glasses are given from the experience of the author. Most of them, however, are known to advanced refractionists and the book in general is not recommended for the beginner. For the American reader it appears odd to find reference made to the prescribing of the monocle.

H. Rommel Hildreth.

ABSTRACT DEPARTMENT

EDITED BY DR. WILLIAM H. CRISP

Abstracts are classified under the divisions listed below, which broadly correspond to those formerly used in the Ophthalmic Year Book. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is only mentioned in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. General methods of diagnosis
2. Therapeutics and operations
3. Physiologic optics, refraction, and color vision
4. Ocular movements
5. Conjunctiva
6. Cornea and sclera
7. Uveal tract, sympathetic disease, and aqueous humor
8. Glaucoma and ocular tension
9. Crystalline lens
10. Retina and vitreous
11. Optic nerve and toxic amblyopias
12. Visual tracts and centers
13. Eyeball and orbit
14. Eyelids and lacrimal apparatus
15. Tumors
16. Injuries
17. Systemic diseases and parasites
18. Hygiene, sociology, education, and history
19. Anatomy and embryology

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1. GENERAL METHODS OF DIAGNOSIS

Bujadoux, A., and Kofman. **A new pupillary reflexometer.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., p. 243.

Bujadoux and Kofman describe in detail their new apparatus for accurate study of the pupillary reflex. They note the importance of minute study of the reflex in syphilis and in other diseases having nervous system involvement.

Phillips Thygeson.

Ferree, C. E., and Rand, G. **The testing of visual acuity. 2. The comparative merits of test objects and a new type of broken circle as test object.** Amer. Jour. Ophth., 1934, v. 17, July, pp. 610-618.

Grusdev, B. F. **Methods of examination of stereoscopic vision.** Sovietskii Viestnik Opht., 1934, v. 4, pt. 4, p. 383.

The author tested the stereoscopic vision of fifty sailors, using the Zeiss stereoscope, the Hering test of falling bodies, and the Hering rod test. The author concludes that the Zeiss instrument is superior in accuracy to the other tests. The Hering rod test measures stereoscopic adaptability and not stereoscopic acuity, because patients improve with practice. The Hering falling-body test should be given with care because the falling is so rapid that many patients do not see it and their replies are merely guesswork. Latent strabismus of one percent was found in a number of patients, without interfering with stereoscopic vision. Strabismus of four percent impaired stereoscopic accuracy. There was no evidence of fatigue of stereoscopic vision after one hour of testing.

Ray K. Daily.

Haseltine, S. L. **Tests for vision malingering.** Hahnemannian Monthly, 1933, v. 68, Dec., p. 924.

Sixteen tests for the detection of malingering are listed.

Lemoine, P., and Valois. **A new slitlamp having homogeneous illumination.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., p. 163.

This new slitlamp differs from the older models principally in the absence of a condenser and in the use of a ribbon filament in place of the usual spiral filament lamp. A perfectly homogeneous illumination is thus secured.

Phillips Thygeson.

McConnell, A. A. **Fields of vision in connection with intracranial lesions.** Brit. Med. Jour., 1933, Aug. 5, p. 226.

The author briefly describes six cases of intracranial tumor and demonstrates the visual field defects caused by these lesions.

M. E. Marcove.

Marquez, G., and Soriano Jimenez. **Tuberculin diagnosis.** Klin. M. f. Augenh., 1934, v. 92, May, pp. 628-641.

After study of 126 patients the authors conclude that the Calmette reaction is diagnostically useful and entirely harmless. Normal subjects do not react at all, or require at least a one percent solution to bring about a slight reaction, while all patients with tuberculosis react obviously with less than one percent and sometimes to extreme dilutions. Subcutaneous injection of 1 mg. tuberculin to bring about a focal reaction is dangerous and not always conclusive.
F. H. Haessler.

Merritt, H. H., and Moore, Merrill. **The Argyll Robertson pupil.** Arch. Neur. and Psych., 1933, v. 30, Aug., p. 357.

The Argyll Robertson pupil is defined as having the following characteristics: absence of reaction to light, miosis, imperfect dilatation in response to instillations of atropin and to painful stimuli, absence of reaction to vestibular stimulation, and active reaction on accommodation for near objects. The present state of knowledge of the pathways is given, and it is shown that the pupillary light-reflex fibers and the sympathetic fibers run together for a short distance in the anterior end of the brain stem just ventrally to the posterior commissure. A lesion at this point would produce an Argyll Robertson pupil, but the only incontrovertible cases of this kind heretofore reported have been associated with syphilis of the nervous system, except a few cases associated with gliomatous invasion in this region. For all practical purposes the Argyll Robertson pupil is pathognomonic of syphilis of the central nervous system, chiefly of the tabetic or dementia paralytica type. M. E. Marcove.

Munson, E. S. **A new test type.** Amer. Jour. Ophth., 1934, v. 17, Aug., pp. 746-747.

Simpson, R. K. **A tangent rule as a diagnostic instrument.** Amer. Jour. Ophth., 1934, v. 17, Aug., pp. 705-708.

Spinelli, F. **Radiologic researches on crossed symmetric projection of the optic canals in the fixed skull.** Riv. Oto-Neuro-Oft., 1934, v. 11, Jan.-Feb., pp. 18-46.

The writer describes his own technique for radiographic study of the optic canals in crossed symmetric projection with Giordano's craniograph. He comes to the following conclusions: The said projection leads to detection of slight pathologic changes. The images of the two canals appear normally different in size and shape. Crossed projection rarely gives symmetric radiographic images but shows constantly the relation between the canals and the inferior portion of the sphenoidal fissure. Asymmetries are due to defects of development or other anomalies. (Numerous figures, bibliography.) M. Lombardo.

Traquair, H. M. **Fields of vision in intracranial lesions.** Brit. Med. Jour. 1933, Aug. 5, p. 229.

This is a very interesting and well written paper on the field of vision in intracranial lesions. A helpful chart is inclosed showing the location of the lesions and the field defects produced. Perimetry is of value in locating the site of the lesion, in determining its nature, in guidance as to prognosis and treatment, and in throwing light upon the anatomy of the visual pathways.
M. E. Marcove.

Tscherning, M. **Photometric glasses.** Arch. d'Opht., 1934, v. 51, June, p. 337.

These lenses, which consist of a filter of neutral gray gelatin between two plano lenses, are numbered in a series from one to ten. Number one allows 1/10 of the incident light to pass, number two 1/100, and so on. Combinations may be used, as in ordinary test lenses. The method of constructing and testing these lenses is described, and a description of a mounting for their use over the patient's eyes is given. A table and graphs of the light absorption qualities of various other filters accompany the article. M. F. Weymann.

Weill, G. **Interferometry in the diagnosis of iridocyclitis supposedly**

tuberculous in origin. Bull. Soc. Franç. d'Opht., 1933, 46th year, pp. 435-439. (See Amer. Jour. Ophth., 1934, v. 17, Feb., p. 174.)

Zanen, J. **Preliminary note on functional ocular alternation. Application in the detection of malingering.** Bull. Soc. Belge d'Opht., 1933, no. 67, p. 77.

The author doubts simultaneity of the two eyes in visual perception. In one experiment he places a red glass before one eye and a green glass before the other and has the subject face a visual acuity chart 5 m. distant. The characters on the chart appear black while the body of the chart is colored, not gray but either green or red. If the subject continues to view the chart the first color, green for example, will be replaced by red at the end of a few seconds, and the colors alternate in rhythm. The experiments are varied by using different colors and by addition of lenses and prisms. The conclusion is reached that in normal persons there exists a phenomenon of functional ocular alternation especially distinct for colors, and that there is not a continual simultaneity of visual perception. The phenomenon lends itself well to detection of malingering. J. B. Thomas.

2. THERAPEUTICS AND OPERATIONS

Barrada, M. A. **My experience with pantocaine.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 192.

The author prefers pantocaine to cocaine because it is cheaper, is not spoiled by boiling, does not affect the corneal epithelium, does not dilate the pupil, and has no legal restrictions.

Edna M. Reynolds.

Beauvieux. **The treatment of follicular tuberculosis of the eye by methylic antigen.** Bull. Soc. Franç. d'Opht., 1933, 46th year, pp. 230-240. (See Amer. Jour. Ophth., 1933, v. 16, Dec., p. 1116.)

Demetriadis, Jean. **Ocular anesthesia with panthesine.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 177.

The author has entirely discarded cocaine as an ocular anesthetic and has substituted panthesine (aminobenzoate-N diethylleuctnol) in five percent solution. Panthesine does not injure the corneal epithelium and does not dilate the pupil or cause a rise in tension.

Edna M. Reynolds.

Duggan, J. N. and Nanavati, B. P. **Treatment of external eye diseases with ultraviolet light.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 221.

A description of the Birch-Hirschfeld carbon-arc damp, the types of filters used, the duration of exposures, and the types of cases treated is given. Ultraviolet light was found most useful in hypopyon ulcers, episcleritis, and phlyctenular conjunctivitis and keratitis. The Birch-Hirschfeld lamp is preferred to the mercury vapor lamp, because exposures do not require accurate timing and can be given with a dilated pupil without harm to the lens. The greatest disadvantage is that lengthy exposures and many sittings are required to bring about healing.

Edna M. Reynolds.

El-Bakly, M. A. **Milk injections.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 179.

The indications and contraindications of foreign protein therapy by milk injections are listed and the regulation of dosage is outlined. The author prefers the poorer grades of milk to certified or pasteurized milk, on the theory that the shock-producing properties of milk depend largely on its bacterial content. An outline of the results of milk injections in thirty cases is appended. Edna M. Reynolds.

Filatov, W. **Expulsive hemorrhage and new means to combat it.** Arch. de Oft. Hisp.-Amer., 1934, v. 34, June, p. 289. (See Amer. Jour. Ophth., 1934, v. 17, June, p. 551.)

Gill, W. D. **Reconstructive surgery in ophthalmology and otolaryngology.** Texas State Jour. of Med., 1934, v. 29, Feb., p. 616.

Gill uses antistreptococcus serum or staphylococcus bacteriophage before operating in tissue that may harbor dor-

mant organisms. Acriflavine is used as a surface antiseptic. Various types of skin graft are discussed, and complications described. Complete photographic and plaster cast records are made.

John C. Long.

Gnanadickam, G. J. **Pantocaine in eye surgery.** Indian Med. Gazette, 1933, v. 68, July, p. 376.

The author points out the advantages of pantocaine over other local anesthetics commonly used in the eye. Anesthesia starts in about 50 seconds with a single drop of 2 percent pantocaine while 4 percent cocaine requires 90 seconds. With 2 percent pantocaine, the anesthesia lasts from 10 to 12 minutes, while with 4 percent cocaine the anesthesia lasts from 7 to 12 minutes. Three hours after instillation pantocaine had no effect whatever upon the iris dilator, intraocular tension, or accommodation. The cornea was also unaffected. For infiltration anesthesia, pantocaine 1 to 1000 has the advantage over novocaine 2 percent in that anesthesia comes on earlier, is more lasting, and leaves less "after tenderness." One to five hundred pantocaine is cheaper than 2 percent novocaine. M. E. Marcove.

Hoede, K. **Roentgen therapy in skin lesions near the eye.** Med. Klin., 1934, v. 30, June 1, pp. 734-736.

Systematic studies over a period of three years concerning lesions of the eye in roentgen-ray therapy show that no damage is done when the eye is properly protected and correct dosage is employed.

Bertha Klien Moncreiff.

Klitzsch, H. **Experience with sodium Evipan narcosis in eye operations.** Klin. M. f. Augenh., 1934, v. 92, May, pp. 653-655.

Sodium Evipan narcosis is a not completely harmless procedure which for eye operations is superior to ether and avertin. The dosage cannot be tabulated. One gives a ten percent solution intravenously at the rate of 1 c.c. in fifteen seconds until the patient no longer responds when spoken to, but still reacts to mechanical stimuli. An added injection of 1 to 2 c.c. is adequate for ocular operations. Combined with local anesthesia, sodium Evipan is ideal and is used by Klitzsch for all operations for which local anesthesia alone is not adequate. F. H. Haessler.

Wheeler, J. M. **Principles of modern surgery in ophthalmology.** Amer. Jour. Ophth., 1934, v. 17, Aug., pp. 683-688.

3. PHYSIOLOGIC OPTICS, REFRACTION, AND COLOR VISION

Cowan, Alfred. **Newer forms of bifocals.** Arch. of Ophth., 1934, v. 11, April, pp. 611-616.

The author discusses the different types of bifocals and points out the incorrectness of the claims made as to elimination of color aberration, the astigmatism of oblique pencils, and the prismatic displacement at the edge of the segment. He concludes that for ordinary powers a minus-6-back one-piece bifocal for the hyperope and the fused plus-6 spherical base for the myope answer the requirements of good lens form. J. Hewitt Judd.

Doherty, W. B. **A special presbyopic glass.** Amer. Jour. Ophth., 1934, v. 17, July, p. 632.

Dunstan, W. R. **Variation and refraction.** Brit. Jour. Ophth., 1934, v. 18, July, p. 404.

It has been asserted that a proportion of myopes arise simply as variations in growth and are not necessarily pathological in origin. Observations of many investigators are set forth in a comparative table together with reference to the author's investigation of 1,080 pairs of eyes in children, which gave a coefficient of correlation between sphere and cylinder of plus 0.31 (plus or minus 0.02); the regression equation showing a rise of half a cylinder with unit increase of sphere.

D. F. Harbridge.

Eames., T. H. **Low fusion convergence as a factor in reading disability.** Amer. Jour. Ophth., 1934, v. 17, Aug., pp. 709-710.

Feldman, J. B. **Improved illiterate test chart cabinet.** Amer. Jour. Ophth., 1934, v. 17, July, p. 632.

Gassowsky, L. N. and Samsonowa, V. G. **The effect of astigmatism of the anterior corneal surface upon the total amount of ocular astigmatism.** Graefe's Arch., 1934, v. 132, p. 297.

Among 300 eyes examined, in 167 or in 55.7 percent the amount of the total astigmatism differed not less than 0.5 diopter from that of the astigmatism of the anterior surface of the cornea; this difference in several cases amounting to from 2 to 3 diopters. In those cases where a difference existed, it happened very frequently that the total astigmatism of the eye was less than that of the anterior corneal surface.

H. D. Lamb.

Good, Palmer. **Kinetic velonoscopy.** Amer. Jour. Ophth., 1934, v. 17, Aug., pp. 711-717.

Haldane, J. S. **Vision of brightness and color.** Brit. Med. Jour., 1933, Dec. 23, p. 1153.

Brightness has no meaning except in relation to darkness. The colors which we see depend on other colors in the visual field, and by altering the surrounding color we can completely change the color of a surface illuminated by light of any visible wavelength. The colors of things, as well as their brightness, are relative to one another.

Edna M. Reynolds.

Kisin, P., and Eidelman, B. **The Stilling, Nagel, and Ishihara plates in natural and artificial illumination.** Sovietskii Viestnik Opht., 1934, v. 4, pt. 4, p. 355.

As to the Stilling, Nagel, and Ishihara tests for color blindness, the tabulated and charted report leads to the following conclusions: The Ishihara test is rapid, sensitive, accurate, differentiates between red and green blindness, and is least dependent on daylight. The Stilling plates, a number of which are unnecessary and not altogether accurate, are very sensitive and capable of detecting slight deviations; but they are dependent on daylight, are time consuming, and require an experienced examiner. The Nagel test also requires considerable experience and time; it differentiates between total and partial color blindness, and daylight is essential to its accuracy. The author suggests that doubtful cases be subjected to the Stilling and Ishihara tests.

Ray K. Daily.

Krämer, R. **Concerning contact glasses.** Wien. klin. Woch., 1934, v. 47, June 8, pp. 724-726.

The author gives a short description of a trial set of thirty-nine contact glasses and their use in keratoconus, myopia, and anisometropia. In diseases of the cornea they may prove very beneficial when used instead of a bandage.

Bertha Klien Moncrieff.

Luckiesh, M., and Moss, F. K. **A correlation between pupillary area and retinal sensibility.** Amer. Jour. Ophth., 1934, v. 17, July, pp. 598-601.

Montfort, R. N. **A new method for the study of retinoscopy.** Jour. Michigan State Med. Soc., 1933, v. 32, Nov., p. 577.

A method of self-retinoscopy useful for teaching purposes is described. The light from an electric retinoscope before one eye is allowed to fall upon the image of the other eye in a mirror at a distance of half a meter. By employing a trial frame any type of ametropia may be produced and then corrected by holding correcting lenses in position before the eye. This method is not recommended by the author for estimating one's own refraction, because of the impossibility of using a cycloplegic.

Edna M. Reynolds.

Ostwalt, F. **Concerning the form of correcting lenses to punctate images.** Arch. d'Opht., 1934, v. 51, July, p. 452.

This article consists of an explanation of the trigonometric calculation and curves of a series of corrected lenses in which the various light pencils are considered as directed toward the image of the center of rotation formed by the combination of the eye plus the correct-

ing lens. Much of the matter is highly technical, with numerous equations and curves. The writer deplores the fact that France has not taken advantage of his calculations to manufacture a corrected lens, and he hopes that lenses will be manufactured commercially from these new calculations, which he considers more accurate than those calculated from pencils directed toward the image of the center of rotation formed by the lens alone.

M. F. Weymann.

Samoilov, A., and Kotliarevskaia, S. **Clinical studies in color blindness.** Sovietskii Viestnik Opht., 1934, v. 4, pt. 4, p. 342.

A tabulated report of the examination of seventy color blind and thirty with defective color vision with the Stilling plates shows that the use of all the plates in the block is a waste of time. The eighteenth edition of the Stilling plates is more accurate than the sixteenth, and for the practical purposes one needs only the first and second plates of group five and the second plate of group three. Correct reading of these plates is diagnostic of normal color perception, and a single mistake is sufficient for diagnosis of defective color vision, and brands the subject unfit for railroad service. Of the sixteenth edition the second charts of the first, second, and fourth groups and the first chart of the tenth group are sufficient.

Ray K. Daily.

Sédan, J. and Roux, A. **Paralysis or congenital absence of accommodation in three brothers.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., p. 163.

The authors report the finding of three cases of congenital paralysis or absence of accommodation in the same family. The three brothers were normal in all other respects. No history of similar defect in parents or grandparents could be elicited.

Phillips Thygeson.

4. OCULAR MOVEMENTS

Amin, M. **An operation of advancement without resection.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 8.

In this operation for concomitant convergent squint, the muscle is tucked and the resulting loop is brought forward and attached to the sclera at the limbus. Good results have been obtained in high as well as in low angles of squint.

Edna M. Reynolds.

Attiah, M. A. H. **Ocular palsies.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 129.

Of nine cases, four were of unilateral third nerve paralysis of fairly sudden onset, in patients between fifty and sixty years of age; and three of these were probably due to cold or rheumatism and one to a nuclear lesion. Two cases of unilateral ophthalmoplegia are reported in which the ophthalmic branch of the trigeminal nerve and the optic nerve were implicated. One was due to syphilitic infiltration at the apex of the orbit and the other to lymphocytic infiltration in lymphoid leukemia. Three cases of abducens paralysis are reported, one due to a pontine tumor, the other two following spinal anesthesia with stovaine.

Edna M. Reynolds.

Bartels, Martin. **The origin of twilight nystagmus of the eyes in man.** Zeit. f. Augenh., 1934, v. 83, May, p. 172.

There still is no unanimity of opinion as to the cause of miner's nystagmus. Dull illumination and the gaseous content of the coal have been postulated, while Ohms ascribes an important rôle to the vestibular apparatus. Bartels contributes some observations on patients in whom a bandage or pinhole spectacle for retinal detachment produced nystagmus. Two of these were miners who had had nystagmus before, but the other two had presumably had a normal muscular mechanism. Bartels does not abandon his view that nystagmus is but an exaggeration of the act of normal fixation. This is accomplished by means of a very large number of very small oscillations.

Whether the center for these oscillations is in the thalamus, the substantia reticularis, or Deiters' nucleus or in all three one cannot say. Nor can we say why miners get a pendulum-like oscil-

lation and amblyopes and blind patients have a jerky nystagmus.

F. H. Haessler.

Braun, George. **Visual field studies in strabismus.** Klin. M. f. Augenh., 1934, v. 92, May, pp. 600-613.

In alternating strabismus the field is normal in each eye. In monolateral strabismus the field of the guiding eye is normal. The peripheral limits of the field of the deviating eye are normal. On the other hand, upon monocular examination a semilunar absolute scotoma can be found on the temporal side with a one-millimeter object, and it becomes larger when the better eye is used for fixation. It is larger when visual acuity is lower. Its nasal border then encroaches upon the center and may overstep the center when visual acuity is very low and central fixation uncertain. The scotoma includes a central scotoma, and apparent central fixation is simulated in that an eccentric retinal area takes over the function of the fovea, and the eye habituates itself to the paracentral fixation. This assumption is supported by the fact that the blind spot is found in the expected location. The scotoma is not a primary congenital defect but is secondary, a suppression in the area of the retina on which the image falls. It occurs in patients with normal as well as abnormal retinal correspondence and may be permanent. F. H. Haessler.

Dor, Louis. **Strabismus and avitaminosis.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., pp. 431-434. (See Amer. Jour. Ophth., 1934, v. 17, Feb., p. 178.)

5. CONJUNCTIVA

Attiah, M. A. H. **A comment on the symptomatic treatment of spring catarrh with injections of splenic extract.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 195.

Inhibition of eosinophilia by intramuscular injection of splenic extract is the basis of treatment of spring catarrh by this method. Fifty cases were treated over a period of three years. He found no change in size, form, or number of the palpebral papillae or the bulbar excrescences, and no reduction in the number of eosinophiles in the blood or in conjunctival smears. Local instillations of splenic extract or subconjunctival injections are suggested. Edna M. Reynolds.

Borel, G. **A new oculopalpebral syndrome.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., pp. 168-178. (See Amer. Jour. Ophth., 1934, v. 17, June, p. 560.)

Dejean, C., and Temple, J. **Some special cases of follicular conjunctivitis.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., p. 143.

Dejean and Temple describe four cases of follicular conjunctivitis having unusual clinical characteristics. Bacteriological studies were negative and inclusion bodies could not be found. Histologically the lesions consisted of hypertrophy of the adenoid tissue of the conjunctiva. Careful biomicroscopic studies are reported.

Phillips Thygeson.

Deweiry, H. M. **The thermophore and its application to trachoma.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 212.

The thermophore was employed in the treatment of thirty-four cases of trachoma, eight being treated on account of lid lesions and the remainder on account of corneal lesions. A temperature of 130 to 140° was used and three or four applications of one minute each were made. Cases having fairly smooth lids but suffering from severe corneal affections responded exceedingly well to the thermophore and showed no recurrences. Some of the cases which had rough lids showed recurrence of symptoms, but corneal lesions responded quickly to treatment with the thermophore. In the treatment of lid lesions, thermotherapy was unsuccessful. Edna M. Reynolds.

El-Bakly, M. A. and Abbassi, A. F. **The diagnostic value of Tricoire's reaction in trachoma.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 61.

Forty cases showed the greatest percentage of positive reactions in active

stages T.2a and T.2b. But even in these most active cases there were only fifty-four percent of positive reactions. Twenty-five percent of the healthy patients showed a positive reaction. Similar inconclusive results by other authors are quoted and the conclusion drawn that the reaction is of little or no diagnostic value.

Edna M. Reynolds.

Fadl, M. Abul. **Treatment of trachoma.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 205.

Hydnocreol oil is found very similar in effect to chaulmoogra oil in the treatment of trachoma. In a group of selected cases hydnocreol was applied twice weekly by friction, alternated with ten percent copper sulphate. This was very effective in mixed infections.

Chaulmoogra oil and copper sulphate combined in an ointment applied once weekly were found very effective in active corneal pannus. After breaking down the pannus as quickly as possible, the author recommends using the chaulmoogra oil and copper sulphate alternately, as alternate use is much less drastic than combined.

Edna M. Reynolds.

Graves, Basil. **Certain clinical features of the normal limbus.** Brit. Jour. Ophth., 1934, v. 18, June, p. 306, and July, p. 369.

The author explains that this is not intended to be an exhaustive study. It is, however, of such length and complexity that it does not lend itself to presentation in a short abstract.

D. F. Harbridge.

Lichaa, E. **A primary ocular mycosis due to "Beauveria Brumpti-Langeron and Lichaa."** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 91.

A case of keratoconjunctivitis due to a hitherto unknown fungus is reported. The submaxillary and the preauricular glands were palpable but not tender or fluctuant. A small nodule at the upper limbus showed three punctiform abscesses and a corneal ulcer with punched-out edges. The upper lid showed a shallow ulceration which appeared to be the point of inoculation. The upper cul-de-sac was filled with translucent gelatinous elevations. A culture showed mycelia.

Edna M. Reynolds.

Meyerhof, Max. **Clinical considerations on acute trachoma and follicular conjunctivitis.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 47.

Three clinical cases are reported, one of follicular conjunctivitis, one of mild acute trachoma, and one of acute trachoma with severe sequelae. The author concludes that the only possibility of differentiating between acute trachoma and follicular conjunctivitis during the first six weeks is in careful examination of the cornea, which in trachoma shows elongation of the meshwork of limbal loops, together with a hazy cornea and granulations of the upper limbus.

Edna M. Reynolds.

Olitsky, P. K. **Bacteriological studies on spontaneous conjunctival folliculosis of monkeys.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 41.

Spontaneous conjunctival folliculosis of monkeys is found to be due to a hitherto undescribed bacterium capable of reproducing the disease in normal monkeys and apes. The organism has certain resemblances to B. granulosis, as to genus but not as to species.

Edna M. Reynolds.

Rice, C. E., Sory, R., Smith, J. E., Faed, P. E., and Drake, A. A. **The effect of diet and vitamins on trachoma.** Amer. Jour. Ophth., 1934, v. 17, Aug., pp. 735-741.

Roche, C. **Infrequent dressings in the treatment of purulent ophthalmia of the new-born.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., p. 188.

Roche is of the opinion that the gonococcus cannot invade the intact cornea. Consequently he avoids all traumatism which might damage the corneal epithelium. He avoids frequent irrigations since in untrained hands the cornea is frequently damaged, and he confines the treatment to daily dressing

which consists first in irrigation with potassium permanganate solution and second in instillation of two drops of two percent silver nitrate solution. A bland ointment is used to prevent agglutination of the lashes. In sixty-three cases, in which gonococci were found, no corneal ulcers developed.

Phillips Thygeson.

Sabata and Gregler. **Malignant melanoma of the caruncle.** Ceskoslovenska Ofthalmologie, 1933, v. 1, no. 3, pp. 145-147.

On the right caruncle of a man of twenty years, a new growth 3 by 3 mm. developed from a congenital nevus. It was pigmented. From the histologic picture the author thought it a basal-cell tumor, and he agrees with Unna and Deyl that nevi are probably of ectodermal origin. G. D. Theobald.

Tobgy, A. F. **Differences in vascularization in spring catarrh and trachoma.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 88.

In spring catarrh the conjunctival vessels are fewer in number, have a smaller lumen, and are less filled. They are not constricted promptly on pressure or on instillation of adrenalin. In spring catarrh only the periphery of the papilla becomes slightly paler after instillation of adrenalin, while in trachoma the red color of the conjunctiva changes to a general pallor. In bulbar or corneal spring catarrh the vessels of the network run straight and fine. In trachoma, the vessels do not run straight. They anastomose freely and there is more congestion. In spring catarrh, the vessels are obliterated soon after the infiltrations have disappeared, but in trachoma they remain long after the cornea has cleared.

Edna M. Reynolds.

Tobgy, A. F. **Peculiar round red-stained bodies in trachomatous tissue of eyelid and cornea.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 85.

The upper part of the cornea became covered with an orange-yellow mass that extended about 1 to 5 mm. beyond the limbus and encroached on the sclera. The slitlamp revealed a network of fine capillaries veiled by a yellow mass which in retroflected light appeared like myriads of small oily globules. Microscopic sections showed a dense infiltration of round and plasma cells, and between these a large number of red-stained globules with eccentric blue nuclei (hematoxylin-eosin stain). These changes were present in one eye only, and disappeared spontaneously after removal of a small portion for microscopic examination.

Edna M. Reynolds.

Villard, H. and Dejean, C. **Experimental researches on corneal wounds caused by the electric knife.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., p. 208.

The action of the electric knife on the cornea of the rabbit is studied histologically. The authors conclude that only with great caution can the knife be used on the eye, because of its distant action. In ocular surgery it would be useful for removal of neoplasms and also, because of its hemostatic action, for destruction of angiomata. The wounds which it produces are large and irregular but cicatrize rapidly. Phillips Thygeson.

Wostry, Milos. **Lymphatic cysts in essential conjunctival atrophy.** Ceskoslovenska Ofthalmologie, 1933, v. 1, no. 3, pp. 157-161.

A case of bilateral atrophy of the conjunctiva with cyst formation accompanied a general skin disturbance. No bacteria or eosinophilia were found in the secretion. The author says that the cyst formation was due to chronic inflammatory infiltrates compressing the lymphatics at irregular intervals.

G. D. Theobald.

6. CORNEA AND SCLERA

Attiah, M. A. H. **Blue sclerotics.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 96.

Two cases of blue sclerotics associated with hereditary idiopathic fragility of the bones are reported in detail. One case had a marked exophthalmos and enlargement of the thyroid.

Edna M. Reynolds.

Cuénod, A. and Nataf, R. **Primary preeruptive adenitis in a case of herpes zoster ophthalmicus.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., p. 201.

Cuénod and Nataf report a case of herpes zoster ophthalmicus in which a swelling of the preauricular lymph node preceded the cutaneous lesions by some days. The authors refer to the statement of Ramon who says that primary zosterian adenopathy develops before the cutaneous signs.

Philips Thygeson.

Deweiry, H. M. **The thermophore and its application to trachoma.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 212. (See Section 5, Conjunctiva.)

Kraupa, Ernst. **Epithelial and endothelial dystrophies.** Zeit. f. Augenh., 1934, v. 83, May, p. 179.

Epithelial dystrophy, described by Fuchs in 1910, has no relation to the secondary changes in the corneal epithelium, which are an expression of parenchymatous injury after trauma, herpes, syphilis, uveal inflammation, or a late sequel of glaucoma. The dystrophy is often associated with glaucoma but is not its result as is keratitis bullosa. Nor is the dystrophy identical with the hereditary epithelial disjunction described by the elder Szily, which is followed by recurrent erosion and filamentous keratitis. Fuchs' terminology, Kraupa's description of pigment masses on the posterior corneal surface, and Vogt's descriptions are discussed, as well as later additions by Koeppe, Staehli, Graves, the Friedenwalds, Triebenstein, and Sallmann. As a useful classification Kraupa suggests the following:

A—(1) Primary epithelial dystrophy: disjunctio epithelii (Szily), hereditary. (2) Secondary epithelial dystrophy, including: epithelial dystrophy as part of a neurotrophic disturbance of the entire cornea (heredity not demonstrated); epithelial dystrophy consecutive to hereditary endothelial dystrophy; and juvenile epithelial dystrophy (familial). B—Primary endothelial dystrophy (Sallmann), including dew-drop endothelium, and the Koeppe-Staehli type (hereditary).

F. H. Haessler.

Redslob, E. **Duplication of Descemet's membrane. Development.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., p. 216.

Redslob reports the histological examination of an eye enucleated because of staphyloma resulting from previous parenchymatous keratitis. At the periphery Descemet's membrane was normal but in the center there was doubling of the membrane, forming a cavity filled with albuminous fluid. At certain points the cavity was crossed by membranous bridges formed of homogeneous membrane and fibrinous masses. The two surfaces of the new membrane were covered with apparently normal endothelium, as was the original membrane.

The author reviews the various theories of the origin of the cornea and in particular of Descemet's membrane. He concludes that on the basis of embryologic, histopathologic, and experimental studies it is certain that the membrane is elaborated either directly or indirectly by the endothelium.

Phillips Thygeson.

Tobgy, A. F. **Peculiar round red-stained bodies in trachomatous tissue of eyelid and cornea.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 85. (See Section 5, Conjunctiva.)

Tobgy, A. F. and Wilson, R. P. **A contribution to the study of xerophthalmia.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 69.

Theories of causation and the various clinical forms are discussed. In Egypt keratomalacia is extremely rare, which the author ascribes to the fact that even the very poor classes in Egypt live on a diet fairly rich in vitamin A.

Edna M. Reynolds.

Vasek, Emil. **Interstitial keratitis and gumma of the lacrimal-sac region.** Ceskoslovenska Ofthalmologie, 1933, v. 1, no. 3, pp. 162-165.

A boy aged six years who had congenital lues developed interstitial kera-

titis of both corneae and a gumma in the region of the lacrimal sac on the right side. G. D. Theobald.

Viallefont, H. **Corneal lesions and the posterior cervical sympathetic syndrome.** Bull. Soc. Franç. d.Opht., 1933, 46th yr., p. 205.

Viallefont discusses the posterior cervical sympathetic syndrome which is characterized by occipital headaches, vertigo, tinnitus, auricular pain, and ocular troubles. He reports on three patients having cervical rheumatism and the typical syndrome, who also had corneal ulcerations associated with diminished sensation. The corneal lesions were resistant to the usual treatment but healed when the cervical rheumatism was relieved by diathermy and radiotherapy. The author states that in addition to the well-known neuroparalytic keratitis there are other types of trophic keratitis of less distinct nature, illustrated by the three reported cases. Phillips Thygeson.

Wieland, E. **Vitamin A in keratomalacia.** Münch. med. Woch., 1934, v. 81, May 25, pp. 777-780.

Vogan (Merck), a new vitamin-A preparation, has been used successfully in severe keratomalacia of the new-born. The author denies the antiinfectious properties of vitamin A, but describes its quality in protection of the corneal epithelium. Bertha Klien Moncreiff.

7. UVEAL TRACT, SYMPATHETIC DISEASE, AND AQUEOUS HUMOR

Jess, A. **Concerning sympathetic ophthalmia.** Münch. med. Woch., 1934, v. 81, May 25, pp. 786-788.

The author discusses the theories concerning the origin of sympathetic ophthalmia, giving special consideration to the newest views on the rôle of the tubercle bacillus in this disease. Bertha Klien Moncreiff.

Meller, J. **The tuberculous etiology of sympathetic ophthalmia and some cases of posttraumatic iridocyclitis.** Zeit f. Augenh., 1934, v. 83, May, 145.

Meller's communications on the tuberculous etiology of sympathetic and traumatic uveitis have received scant attention, possibly because the bacteriologic technic is difficult to acquire. He now adds further clinical material in support of his assertions that tubercle bacilli are found in blood and tissue cultures in uveitis. In a case of sympathetic ophthalmia reported in the Salzmann Festschrift the blood culture was macroscopically positive, while tissue culture was microscopically positive. In a very similar case detailed in the present essay the blood culture was negative, tissue cultures microscopically positive. Histologically typical infiltrates were found in the uvea. In a second patient with transient sympathetic inflammation after trauma the blood culture was positive. In the histological preparations there were nests of round cells but no epithelioid cells. In the absence of consecutive inflammation in the second eye the diagnosis could not have been made with certainty. It is not possible to establish a time relationship between the occurrence of positive blood cultures and the beginning of the uveitis, since it is well known that a tissue may frequently become flooded with bacilli which are unable to gain a foothold.

In a third section Meller discusses cases of unilateral iridocyclitis with positive blood culture, without asserting that the finding of tubercle bacilli in the blood at the time of intraocular inflammation definitely establishes the etiology. However, in one-fifth of forty cases of iridocycltis tubercle bacilli were found in the blood when cultures were made at a time of fresh extensions of the iridocyclitis. When the inflammation is severe sympathetic ophthalmia may follow and the danger is greatest when specifically tuberculous granulation tissue develops.

F. H. Haessler.

Purtscher, A. **Tubercle bacillus culture from the tissue of an eye with sympathetic inflammation.** Zeit. f. Augenh., 1934, v. 83, May, p. 163.

In a patient with severe posttraumatic inflammation the second eye be-

came involved in a typical sympathetic inflammation. The first eye was enucleated. The typical histologic picture of sympathizing inflammation as described by Fuchs was found and positive tissue cultures for tubercle bacilli demonstrated the etiology of the inflammation. F. H. Haessler.

Sallmann, L. **A contribution to the bacillary nature of sympathetic ophthalmia.** Zeit. f. Augenh., 1934, v. 83, May, p. 168.

In a child a penetrating wound of the right eye was followed by severe inflammation and finally shrinking of the eye. Later the left eye became inflamed. The right eye was enucleated and a sympathizing inflammation with signs of an old endophthalmitis septica was found in histologic preparations. Tissue cultures from the eye revealed the presence of tubercle bacilli.
F. H. Haessler.

Salvati. **Some ocular complications of small pox.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 170.

Two cases of iridocyclitis without any preceding involvement of the conjunctiva or cornea are reported. They are considered toxic in nature. They subsided after ordinary symptomatic treatment with atropin and hot compresses. Edna M. Reynolds.

Schieck, F. **Highly allergic phase in the course of iris tuberculosis and its treatment.** Zeit. f. Augenh., 1934, v. 83, June, p. 257.

In two patients with smoldering serofibrinous tuberculous iritis the picture was suddenly changed to severe, highly inflammatory plastic iritis with tubercle formation. In neither of these is injection of the patient's own blood into the anterior chamber indicated. This method is useful in torpid inflammation which fails to heal presumably because no antibodies reach the tissues bathed by the aqueous. In the two cases here reported the eyes were treated with ultraviolet light and very small doses (2 to 100,000) of bacillary emulsion were given repeatedly without increase in dose. Both patients responded well.
F. H. Haessler.

Villani, G. **Condition of the ciliary muscle in atrophy of eyeball.** Ann. di Ottal., 1934, v. 62, June, p. 483.

In determining the part the ciliary muscle plays in postcyclitic bulbar atrophy the author has studied the changes discoverable at varying stages of atrophy. He reports twelve clinical histories and microscopic examinations in atrophic globes over periods varying from one month to fourteen or fifteen years, and even to twenty or twenty-five years. From the data accumulated and the material showing the changes in the ciliary muscle he has been able to establish the period at which atrophy occurred. From the clinical and pathological findings he is able to distinguish three postcyclitic periods of atrophy: (1) the period of infiltration and alteration of the muscle fibers (1 to 5 months); (2) the breaking up and dissociation of the fibers with vacuolation and hyaline degeneration (1 to 14 or 15 years); (3) total destruction of the muscle and fibrous degeneration (20 to 25 years). There may also be a fourth period of osseous degeneration. (Two plates, bibliography.) Park Lewis.

8. GLAUCOMA AND OCULAR TENSION

Bailliart, P. **Clinical considerations on atrophic excavation of the optic nerve without ocular hypertension.** Bull. Soc. Franc. d'Opht., 1933, 46th yr., p. 407. (See Section 11, Optic nerve and toxic amblyopias.)

Green, John. **Medicosociologic aspects of chronic glaucoma.** Jour. Missouri State Med. Assoc., 1934, v. 31, Jan., p. 6.

The author recommends the following methods of preventing blindness from chronic glaucoma: (1) education of the public to seek expert advice when vision fails in middle age or later; (2) education of the optometrist in the signs and symptoms of early glaucoma; (3) education of the family physician to secure examination by an ophthalmologist for every patient past middle age whose vision is not satisfactorily improved by glasses; (4) education of the ophthalmologist to give every patient of forty-

five years or over as complete an ocular examination as if clear-cut signs of glaucoma were present; and (5) education of the patient as to the nature of his disease and the necessity for prolonged and unremitting care.

Edna M. Reynolds.

Hardesty, J. F. **Infantile glaucoma.** Amer. Jour. Ophth., 1934, v. 17, Aug., pp. 689-692.

Rinaldi, S. **Glaucosan in the therapy of certain ocular affections with hypertension.** Ann. di Ottal., 1934, v. 62, June, p. 500.

The author used levoglaucosan in twenty-five cases. In the greater number the uvea was involved with hypertension. He concludes that in many cases the levoglaucosan is of great utility, and that it should be more widely known and employed. (Bibliography.)

Park Lewis.

Sallmann, L. **Concerning increased intraocular tension.** Wien. klin. Woch., 1934, v. 47, May 25, pp. 663-664.

The author gives a short summary and evaluation of the current methods of examination useful in various types of glaucoma.

Bertha Klien Moncreiff.

Shapira, T. M. **Micro- and spherophakia with glaucoma.** Amer. Jour. Ophth., 1934, v. 17, Aug., pp. 726-735.

Soleiman, S. A. H. **A case of juvenile glaucoma.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 140.

The patient was thirteen years old. The fundus showed deep glaucomatous cupping and optic atrophy, with an anterior chamber of normal depth.

Edna M. Reynolds.

9. CRYSTALLINE LENS

Amin, M. **Extraction of senile cataract with conjunctival bridge.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 13.

The author favors a long broad conjunctival flap in extraction of senile cataract rather than stitching the flap, because of the additional time and manipulation required for sutures. In discussion, Sobhy Bey recommends the preliminary suture in cases threatening loss of vitreous; Tewfik limits the bridge flap to extraction downward for cataract after trephining for a glaucoma; and Migally does not believe a conjunctival flap necessary in the ordinary case. Edna M. Reynolds.

Arruga, H. **The technic of intracapsular extraction of cataract.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., p. 270.

Arruga describes in detail his technic for intracapsular extraction of cataract, illustrating each step with excellent drawings.

Phillips Thygeson.

Badot, J. **Biomicroscopic examination of diabetic cataract.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., p. 249.

Badot found 101 cases of cataract in 10,000 diabetics of all ages. He states that the cataract occurring in the diabetic of sixty years or older is simply a senile cataract modified or not by the diabetes. The cataract of the young diabetic is different and has the following special characteristics: (1) flocculent subcapsular masses both anterior and posterior, (2) numerous clear slits, and (3) spreading of the lens sutures and vacuoles in the subcapsular cortex. (Drawings from two cases.)

Phillips Thygeson.

Bruner, A. B. **The operative treatment of cataracts.** Amer. Jour. Ophth., 1934, v. 17, Aug., pp. 699-704.

Chaikoff, I. L., and Lachman, G. S. **Occurrence of cataract in experimental pancreatic diabetes.** Proc. Society for Exper. Biol. and Med., 1933, v. 31, Nov., p. 237.

A study of the eyes of completely depancreatized dogs kept alive with insulin is reported. Eight of the ten diabetic dogs showed lens changes varying in degree from peripheral striations to diffuse irregular opacification. It was found that the duration of the diabetes did not determine the extent of the cataractous process and that old age

was not a factor in the production of cataractous changes.

Edna M. Reynolds.

Dejean, Ch. **Total extraction of cataract in two stages.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., p. 254.

Dejean has attempted to diminish the danger of intracapsular extraction by performing the operation in two stages. His technic is as follows: mydriasis, akinesis, and anesthesia are obtained by the usual methods. After corneal section and iridectomy the anterior capsule is ruptured by a needle knife and the nucleus and adherent cortex expelled. Then the capsule is seized with smooth forceps and, after gentle traction to rupture the zonular fibers, is removed, The operation is completed with corneal or conjunctival sutures.

The author states that the principal advantages of the operation are: (1) avoidance of turning of the lens in the eye with the consequent danger of hyaloid rupture, (2) simplicity of technic, and (3) absence of complications if the capsule cannot be removed.

Phillips Thygeson.

Kirby, D. B. and E. Wiener, R. **Senile cataract—a study of the biology and chemistry of the crystalline lens.** Brit. Jour. Ophth., 1934, v. 18, July, p. 388.

A study of the development, growth, structural changes, chemistry, and nutrition of the normal lens in its relation to the etiology of senile cataract is presented. The theory which considers senile cataract germ-plasmatically determined is elaborated upon. Pathological changes in the structural configuration of the lens protein molecules predispose to a lack of resistance of the lens as an organ, to changes in permeability, to changes in water-binding power, and to fatty degenerations. These tend to promote degenerative phenomena of denaturation, coagulation, and precipitation of lens protein, and to induce abnormal infiltration of fat and deposition of inorganic material. The hypothesis considers senile cataract as a genetically induced change in structure of the lens protein molecule, making it susceptible to the physical and chemical phenomena concerned in the production of cataract.

D. F. Harbridge.

Saint-Martin, de. **Two safety procedures in total extraction of cataract.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., p. 258.

De Saint-Martin reviews the various technics of corneal suture which have been advocated during the past forty years and illustrates the important ones with drawings. He prefers the technic of Gomez Marquez, which he describes in detail. He reports that he has operated upon 254 consecutive cases without loss of vitreous and without iris prolapse. He describes a modification of the Van Lint-Villars akinesis, whereby paralysis of the orbicularis muscle is maintained over a period of several days. He uses for injection equal parts of ninety percent alcohol and four percent novocaine. There have been no complications or undesirable effects.

Phillips Thygeson.

Shapira, T. M. **Micro- and spherophakia with glaucoma.** Amer. Jour. Ophth., 1934, v. 17, Aug., pp. 726-735.

Tobgy, A. F. **Intracapsular cataract extraction with electrocoagulation by a newly devised electrode.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 20.

A brief review of the work of Jess and of Lacarrère with electrocoagulation in cataract extraction is given. The author has devised an electrode having three points of traction, which he has used with a current of sixty to ninety milliamperes. The first results are so encouraging that he recommends further trial.

Edna M. Reynolds.

10. RETINA AND VITREOUS

Attiah, M. A. H. **Retinal edema after quinsy.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 114.

The edema disappeared completely within four days under treatment with sodium salicylate and intravenous injections of collosol iodine. The vision remained 6/6 throughout the illness. There was a marked field defect but no

abnormality in the fixation area and no central color scotoma.

Edna M. Reynolds.

Baurmann, M. **Studies on filament formation in the vitreous.** Graefe's Arch., 1934, v. 132, p. 302.

In answer to a paper by Goedbloed of Leyden on the existence of vitreous filaments not as a part of a gel, the author confirms and enlarges on his previous findings of the vitreous as a gel. He rejects the opinion of Goedbloed that the vitreous is not capable of swelling and that a loss of water that has once occurred from the vitreous is not reversible, and believes that vitreous filaments are the gel-forming material of the vitreous colloid and that the volume and consistency of the vitreous are essentially dependent upon this thread substance. Experiments were carried out on vitreous from the eyes of cattle two to three years old; measuring the amount of swelling, and plotting a curve as compared with the volume of the vitreous filaments dried at 110° C., immersion being made in hydrochloric, sulphuric, acetic, and oxalic acids as well as in sodium hydroxide and calcium hydroxide of varying dilutions and varying p_H H. D. Lamb.

Coppez, Henri. **Concerning the conditions which should determine operative intervention in detachment of the retina.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., pp. 355-360. (See Amer. Jour. Ophth., 1934, v. 17, Jan., p. 86.)

Coppez, Léon. **The use of the pyrometric electrode in the treatment of detachment of the retina.** Bull. Soc. Franç. d'Opht., 1933, 46th year, pp. 312-323. (See Amer. Jour. Ophth., 1934, v. 17, Jan., p. 86.)

Dubar, J. **Remarks on functional examination of the retinal circulation.** Bull Soc. Franç. d'Opht., 1933, 46th yr., p. 370.

The author is of opinion that tonoscopy is a valuable diagnostic method, yielding findings of importance in the study of headaches, migraine, and epilepsy. He states that papillary stasis can be discovered even before ophthalmoscopic signs of papilledema become evident. He reviews the possible sources of error in the method.

Phillips Thygeson.

François, J. **Ovarian therapy in retinitis pigmentosa.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., p. 383.

François reviews the work of Wibaut on ovarian therapy in retinitis pigmentosa and reports four cases of the disease treated with an ovarian preparation known as menformon. One hundred mouse units were injected subcutaneously daily over periods of two months or longer. In the first case the visual field became noticeably enlarged but there was no improvement in light sense or in visual acuity. In the second case light sense and visual acuity were improved but the visual fields were not influenced. No result was obtained in the third case. In the fourth, there was marked improvement in light sense and in the visual field but acuity remained unchanged. The author concludes that in a disease of such serious nature ovarian therapy is indicated even though the treatment is not specific.

Phillips Thygeson.

Fritz, A. **Contribution to the physiopathology of the retinal vein.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., p. 375.

Fritz states that histologic examinations have established that thrombi forming in the retinal vein do not form complete obstructions. In most cases there results a slowing of the venous circulation and not a complete arrest. This can be demonstrated on the living eye by means of the ophthalmodynamometer. If the eye is compressed with this instrument the segments of the vein emerging from the edematous papilla are emptied of their blood in two or three seconds, a longer time than necessary in the normal eye. If the pressure is continued the vein will be seen to fill again but can be emptied again by higher pressure. The author believes that the degree of venous obstruction determined by the thrombus can be measured by the time and pressure necessary to determine collapse of the vein.

The observation appears to be of clinical importance since the presence of a secondary glaucoma seems to be related to complete obstruction of the central vein.

Phillips Thygeson.

Genet. **Retinal detachment. Onset with hyalitis.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., p. 286.

Genet reports three cases of retinal detachment which at the time of first examination showed only vitreous opacities. The author believes that the opacities were not the result of hemorrhage, and he suggests that they may have originated in rupture of retinal cysts, which at the same time produced retinal tears leading to detachment of the membrane. In discussion Gonin states that the vitreous opacities resulted either from disturbance of the vitreous following its posterior detachment (separation of its liquid and solid parts) or from superficial retinal hemorrhages. Phillips Thygeson.

Genet, L. **Obliteration of retinal tears by diathermocoagulation.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., p. 299.

Genet summarizes the advantages of diathermy in the treatment of retinal detachment. He states that massive hemorrhage, a not infrequent complication of ignipuncture, does not occur with diathermocoagulation. He reports a case in which a retinal tear was exactly obliterated by this method.

Phillips Thygeson.

Goedbloed, J. **Studies on the vitreous. Report 1, the structure of the vitreous.** Graefe's Arch., 1934, v. 132, p. 323.

The slitlamp picture of the vitreous indicates real structure. It shows that, in addition to its filament structure, the vitreous has also a coarser pattern in which the brighter parts are rich and the darker are poor in filaments. Salts with a strong hydrating action produce definite, ultramicroscopically visible increase of hydration in the vitreous filaments and, in sufficient concentration, complete solution of the filaments. Salts with an opposite action produce definite, ultramicroscopically visible diminution of the hydration. Changes in the hydrogen-ion concentration influence the hydration of the vitreous filaments but in less degree than the salt solutions. Toward the alkaline side there occurs increase of hydration, while toward the acid side there is observed a mild diminution. Opacity of the vitreous in acid and strongly alkaline environments depends upon opacity of the interfibrillar vitreous and is not the result of granular destruction of the vitreous filaments. The granulation, which the filaments only show in acid p_H vicinities, must be considered as a deposit of a precipitated albumen upon the fibrillae.

H. D. Lamb.

Gonin, J. **Ocular hypotony in its relation to detachment of the retina.** Arch. d'Opht., 1934, v. 51, July, p. 426.

Hypotony is not a result or cause of detachment of the retina, but is a result of the same underlying pathological condition which brought about the retinal detachment. The hyaloid is in more intimate contact with the equatorial and ciliary region of the retina than posteriorly. Lesions in this former region tend to create more adhesions between hyaloid and retina. Then when degeneration and shrinkage of the vitreous occur, tears are produced in the retina with detachment of that membrane, and at the same time the traction causes some detachment of the choroid. The choroidal detachment which has been observed in specimens and by several observers, is responsible for the hypotony which follows. Thermopuncture temporarily increases the hypotony, but later has the effect of obliterating the choroidal as well as the retinal detachment. This tends to relieve the hypotonic condition of the globe, so that hypotony is no contraindication to treatment of detachment of the retina by thermopuncture.

M. F. Weymann.

Jeandelize and Baudot. **Our present results in the treatment of retinal detachment by diathermy.** Bull. Soc. Franç. d'Opht., 1933, 46th year, pp. 305-311. (See Amer. Jour. Ophth., 1934, v. 17, May, p. 460.)

Kleiner, Leo. **The subsequent results in the healed cases of retinal detachment operated upon in the II University Eye Clinic in Vienna in the years 1928-1931.** Graefe's Arch., 1934, v. 132, p. 266.

Of eighty-three eyes with retinal detachment, operated upon in the years 1928-1931, sixty-eight have remained healed. Regarding ten cases, it is impossible to obtain any subsequent information. Five cases remain unhealed. Sixteen cases showed recurrences: twelve within six months after the last operation and four within a year. Seven of the cases showing recurrence had been operated upon by the ignipuncture method of Gonin (25 percent of all the healed Gonin cases). Nine had been operated upon with the caustic pencil (18 percent of all the cauterized cases); and of these operations two were performed by the single caustic application according to Guist and seven by the multiple caustic application according to Lindner. Of the eyes with retinal detachment successfully operated upon, 70.3 percent (of which 21 percent were cases of ignipuncture) obtained good vision within the first year and 47.8 percent (of which 77.7 percent were cases of ignipuncture) reacquired normal visual field limits inside of a year. Among the remaining cases, 29.6 percent (of which 27.2 percent were cases of ignipuncture) obtained normal vision in the second year and 52.1 percent (of which 41.6 percent were cases of ignipuncture) showed normal fields of vision in the same interval of time.

H. D. Lamb.

Kravitz, Daniel. **The vasomotor system in retinal and cerebral vascular lesions.** Amer. Jour. Ophth., 1934, v. 17, Aug., pp. 741-745.

Kronfeld, P. C. **The development of the tear-searing operation up to date.** Jour. Missouri State Med. Assoc., 1934, v. 31, Jan., p. 1.

Gonin's method of localization of retinal tears and his treatment by thermocauterization are described in some detail. The objections to his method are summarized and the modifications of his technic to date are reviewed. Heat coagulation of the choroid by diathermy is preferred by the author to Guist's method of chemical cauterization after scleral trephining. Diathermy is much safer for the average surgeon.

Edna M. Reynolds.

Magitot, A. **On certain types of cell encountered in retinal inflammations.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., p. 380.

Magitot notes in retinal inflammations the presence, often in the vitreous or in the subretinal fluid in detachments, of cells varying in diameter from 30 to 60 micra, and occasionally as large as 80 micra, which are characterized by the presence of large protoplasmic vacuoles. The cells contain granular protoplasm and small nuclei almost always peripherally located. The nuclei are of oval shape, are rich in chromatin, and stain rather diffusely with nuclear stains. As the cells mature the vacuoles increase in size, finally replacing the protoplasm and compressing the nuclei. The contents of the vacuoles do not color with fat stains or with any of the ordinary dyes. The author suggests that these cells have their origin in the neurogliar cells of the ganglionic and bipolar cell layers.

Phillips Thygeson.

Pesme, P. **Transitory ophthalmoscopic picture of nephritic retinitis in the course of a syndrome of intracranial hypertension.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., p. 361.

Pesme describes the case of a man, who, six weeks before his death from intracranial neoplasm, showed the complete ophthalmoscopic picture of albuminuric retinitis. Examination of the urine, however, was negative, and five weeks later the macular figure had disappeared to leave a picture characteristic of increased intracranial pressure. The literature on pseudoalbuminuric retinitis is reviewed.

Phillips Thygeson.

Rochat, G. F. **An instrument for immediate localization of retinal tears.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., p. 294.

Rochat describes in detail and illustrates with photographs a new apparatus for immediate localization of retinal tears. Phillips Thygeson.

Rollet, Jacques. **Detachment of the retina and deficiency of the apparatus of fixation and support of this membrane.** Arch. d'Opht., 1934, v. 51, July, p. 431.

The retina is regarded as being kept in its normal position by the passive support of the normal vitreous and by active fixation to the retinal epithelium through its cells and the fibers of Mueller. Detachment occurs through a localized disturbance to nutrition such as retinitis or injury which causes active fixation to be lost by damage to the cells. In addition shrinkage of the vitreous and the weight of the retina cause the first area of detachment. As the subretinal transudate forms to fill the gap between retina and pigment epithelium, its weight and movements of the globe tend to increase the extent of the detachment. The tears found in the detached retina are regarded as due to solution of substance caused by trophic ulcers. The various operative procedures which cure detachment do so by producing physicochemical changes which again permit of active fixation of the retina to the pigment layer and proper support by the vitreous.

M. F. Weymann.

Rubbrecht, R. **Suture in the treatment of detachment of the retina.** Bull. Soc. Franç. d'Opht., 1933, 46th year, pp. 348-354. (See Amer. Jour. Ophth., 1934, v. 17, Jan., p. 88.)

Safar, K. **Treatment of retinal detachment by means of diathermic puncture and its results.** Zeit. f. Augenh., 1934, v. 83, May, p. 189.

In seventy percent of eighty consecutive cases reattachment was obtained. It is clear from a survey of the material that early operation is urgently indicated. F. H. Haessler.

Saint-Martin, de. **Operative procedures in retinal detachment. Indications and results.** Bull. Soc. Franç. d'Opht., 46th yr., 1933, p. 323.

De Saint-Martin states that there are three types of technic which have been developed for the treatment of retinal detachment. The first is illustrated by that of Gonin and is particularly useful in the obturation of isolated tears which are easily accessible. In cases having multiple tears or tears too large to be obturated by a single galvanopuncture, this technic should be superseded either by the chemical cautery technic of Guist-Lindner or the method of choroidal coagulation by high frequency current. The author states that in his hands the latter method has shown the highest percentage of favorable results as well as the fewest complications. He believes that the chemical method, while giving satisfactory results, is much too complicated and laborious for general use. Using the technic of Gonin he has had thirty-one percent reattachments, with the technic of Guist-Lindner thirty-three percent, and with diathermo-coagulation sixty-six percent.

Phillips Thygeson.

Tobgy, A. F., and Attiah, M. A. H. **A review of the recent operative treatment for detachment of retina.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 24.

An outline of the theories which have been advanced to explain the mechanism of detachment is given in some detail. The gradual displacement of actual cauterization and chemical cauterization by electrocoagulation and endothermy is emphasized. Procedures discussed are the Gonin, the Guist-Lindner, the Lindner undermining, the Sourdille, the Larsson, the Weve, and the Safar operation.

Edna M. Reynolds.

Zimmern, Magitot, Tillé, and Brunet. **Radiotherapy of the suprarenal region in disease of the retinal capillaries.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., p. 397.

Influenced by the favorable results obtained in endarteritis obliterans by radiation of the adrenal glands, the authors have applied the technic to cases having retinal vascular disease, particularly those in the early stages of

circinate retinitis. Of a total of nine cases so treated, two were markedly improved, three were slightly improved, and four were unchanged.

Phillips Thygeson.

11. OPTIC NERVE AND TOXIC AMBLYOPIAS

Aubaret and Guillot. **Bilateral infectious optic neuritis in the course of exanthematous fever on the Mediterranean coast.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., p. 402.

A case of exanthematous fever is reported in which bilateral optic neuritis occurred. Complete healing occurred in a few weeks. The authors mention the frequency of conjunctivitis in the disease, some cases of which resemble Parinaud's conjunctivitis.

Phillips Thygeson.

Bailliart, P. **Clinical considerations on atrophic excavation of the optic nerve without ocular hypertension.** Bull. Soc. Franç. d'Opht., 1933, 46th yr., p. 407.

Bailliart reports the case of a woman aged 52 years in whom atrophic excavation of the optic nerve with diminished visual acuity and with visual field changes preceded for two years the appearance of intraocular hypertension. The author states that changes in the vessels in the anterior part of the eye are responsible for hypertension, while similar changes in the posterior part produce excavation of the nerve. While the changes in the two parts of the eye generally begin simultaneously, occasionally one part may be affected first. The author concludes that intraocular tension should be watched in all cases of atrophic excavation. Surgical intervention is indicated only when hypertension is present.

Phillips Thygeson.

Krimsky, Emanuel. **Symmetric incomplete annular scotoma of tobacco origin without enlargement of the blind spot.** Amer. Jour. Ophth., 1934, v. 17, Aug., pp. 722-725.

Kyrieleis, Werner. **Pupillary atony with absent tendon reflexes.** Zeit. f. Augenh., 1934, v. 83, June, p. 278.

Pupillary atony is usually a unilateral affliction. The affected pupil is larger, does not react to light, becomes still larger after total darkness, and only becomes reduced in size again very slowly. The normal side reacts promptly. Contraction with accommodation also takes as much as ninety seconds. The limits of size finally attained are normal. The differentiation from Argyll Robertson pupil becomes difficult in the rare cases in which absence of patellar and Achilles tendon reflexes accompanies the phenomenon.

The etiology is unknown. Signs of neuropathic constitution such as vasomotor and vegetative phenomena were observed in one third of the cases.

F. H. Haessler.

Migally, Amin. **Ocular complications of measles.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 172.

Blindness following measles was due to optic atrophy from subacute meningitis. The literature of ocular complications of measles is comprehensively reviewed. Edna M. Reynolds.

Soleiman, A. H. **Two cases of optic neuritis developing from the effect of cold.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 105.

It was impossible to discover any focus of infection. Both cases occurred after severe chilling of the body, and both recovered completely.

Edna M. Reynolds.

12. VISUAL TRACTS AND CENTERS

Attiah, M. A. H. **A case of severe bilateral papilledema due to a tumor in the parietal region of the brain, with recovery of vision after operation.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 108.

For five months prior to hospital admission, the patient had had attacks of unconsciousness with convulsions, repeated vomiting unrelated to food, intermittent severe headache, failure of vision in the right eye, and diminished hearing on the right side. Intravenous injection of hypertonic salt solution, with ventriculography and withdrawal of cerebrospinal fluid, was followed by

subsidence of the papilledema and complete recovery of vision within a month. Decompression and evacuation of the tumor, which was cystic, have maintained the improvement in vision.

Edna M. Reynolds.

Attiah, M. A. H. **Pituitary tumors.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 117.

Five cases are reported. In the first case, the tumor was of very slow growth and was accompanied by signs of hypopituitarism. In the second case, the tumor was of large size and rapid growth, encroaching on the sphenoidal sinus. In the third and fourth cases, the pituitary derangement started as a physiologic hyperplasia of the gland during pregnancy. Both of these showed temporary improvement under x-ray therapy. The fifth tumor was a carcinoma of the pituitary gland which had compressed the first and second nerves.

Edna M. Reynolds.

Magoun, H. W., and Ranson, S. W. **Loss of pupillary light reflex resulting from lesions in the region of the posterior commissure.** Proc. Soc. for Exper. Biol. and Med., 1933, v. 31, Nov., p. 183.

Experimental work with cats is reported in which the pupillary light reflex was obliterated completely by electrolytic lesions in the pretectal region on each side of the posterior commissure. These experiments confirm work previously done by the same authors from which they concluded that the pupillary light reflex was mediated through the superior colliculus.

Edna M. Reynolds.

Rozner, E. **Disturbances of fusion in diseases of the central nervous system.** Med. Klin., 1934, v. 30, April 20, pp. 546-548.

Periodic diplopia may be due to a supranuclear disturbance of fusion if there is a preexistent heterophoria. In this condition the separation of the double images remains the same in all parts of the visual field. It may be an early symptom in cerebellar tumors and is found also in encephalitis lethargica, tabes dorsalis, multiple sclerosis, syringomyelia and Little's disease, if the neighborhood of the fourth ventricle is damaged. Bertha Klien Moncreiff.

13. EYEBALL AND ORBIT

Friedgood, H. B. **Experimental exophthalmos and hyperthyroidism in guinea pigs.** Bull. Johns Hopkins Hosp., 1934, v. 54, Jan., p. 48.

Experimental hyperthyroidism was induced in guinea pigs by daily intraperitoneal administration of extract of anterior hypophysis. The basal metabolic rate showed three distinct periodic variations. First came a marked increase. This was followed by a striking remission, the rate returning to normal in one to three weeks. The third period was characterized by another elevation. Of thirty animals injected with anterior pituitary extract, nine developed exophthalmos. This was much more marked when it developed after the animal had entered the refractory period, and striking exophthalmos was seen only in animals injected over a period of several months, and especially in those which finally developed abnormally low basal metabolic rates. Exophthalmos is thus produced independently of the thyroid secretion which causes elevation of the basal metabolic rate. The facts lend support to the author's opinion that there is a probable functional insufficiency at certain stages of thyroid hypertrophy. Edna M. Reynolds.

Goldenburg, Michael. **Progressive exophthalmos in thyroid disease.** Amer. Jour. Ophth., 1934, v. 17, Aug. pp. 692-698.

14. EYELIDS AND LACRIMAL APPARATUS

Attiah, M. A. H. **Analysis of cases of proptosis.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 150.

Of forty cases, some of the more unusual are discussed in detail. Tumors were responsible for forty-five percent and accessory sinus disease for twenty percent. Some rare causes were a primary tumor of the optic nerve, microphthalmos with orbital cysts, and organ-

ized blood cysts in the orbit following whooping cough.

Edna M. Reynolds.

Gala, A. **Primary carcinoma of the lacrimal sac.** Ceskoslovenska Ofthalmologie, 1933, v. 1, no. 3, pp. 135-139.

A woman aged sixty-three years noticed a tumefaction in the region of the left lacrimal sac, which gradually increased in size over a period of more than one year. The tumor was the size of a hazelnut, hard, immovable, with irregular surface, and not painful. It extended into the anterior part of the orbit. It was removed January 1, 1933, under local anesthesia, and deep x-ray therapy was used. There is no recurrence to date. Histologic examination showed a typical basal-cell carcinoma. The author could find only twelve cases of primary malignancy of the lacrimal sac reported in the literature.

G. D. Theobald.

Ibrahim, H. A. **Xeroderma pigmentosum.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 145.

Two cases are reported briefly and a detailed description of the characteristic lesions, symptoms, etiology, histopathology, and treatment of this disorder is given. Edna M. Reynolds.

Terson, A. **Treatment of lid eczema.** Bull. Soc. Franç. d'Opht., 1933, 46th year, pp. 180-186. (See Amer. Jour. Ophth., 1934, v. 17, May, p. 466.)

Tobgy, A. F. **Plastic operations for the restoration of the lower lid.** Bull. Ophth. Soc. of Egypt, 1933, v. 26, p. 1.

Three cases of malignant tumor of the eyelids are reported in which successful restoration of the lids was secured by the method of Dieffenbach-Büdinger as given in Meller's Ophthalmic Surgery. Skin and cartilage grafts from the posterior surface of the ear were used to restore the excised tissues. In one case, the procedure was modified so that a portion of the upper lid was restored by a pedicle flap in addition to restoration of the lower lid.

Edna M. Reynolds.

Van der Straeten and Appelmans. **Tooth in a lid and palpebral coloboma.** Arch. d'Opht., 1934, v. 51, July, p. 417.

A review of the literature concerning tumors containing teeth in the region of the eye is given. An original observation concerning a five-year-old boy who had a small tumor mass at the inner portion of the right lower lid which proved to contain a perfectly formed unerupted canine tooth is described. Associated with the tumor was a colobona of the lid. The tooth was visible (but not diagnosed) in x-ray photographs of the tumor before its removal. The tumor was regarded as a developmental defect. M. F. Weymann.

Vasek, Emil. **Interstitial keratitis and gumma of the lacrimal-sac region.** Ceskoslovenska Ofthalmologie, 1933, v. 1, no. 3, pp. 162-165. (See Section 6, Cornea and sclera.)

15. TUMORS

Kahoun, Svatopluk. **Glioma metastasis to atrophic eye?** Ceskoslovenska Ofthalmologie, 1933, v. 1, no. 3, pp. 153-156.

The right eye of a two-year-old boy had a glioma with increased tension. The left eye was congenitally atrophic and frequently irritable. Both eyes were removed. On histologic examination the entire retina of the right eye was found to be destroyed by the tumor, which was also invading the optic nerve. In the left eye several tumor nodules were found near the ora serrata. In this eye there was an infiltration of plasma cells about the vessels. G. D. Theobald.

Knobloch, Rudolf. **A case of extradural spindle-cell sarcoma originating in the optic nerve sheath.** Ceskoslovenska Ofthalmologie, 1933, v. 1, no. 3, pp. 149-150.

The author reports a case of retrobulbar spindle-cell sarcoma originating in the optic nerve sheath and growing extradurally, which because of its pyramidal growth caused blindness previous to the marked exophthalmos. The tumor surrounded the optic nerve and eyeball, causing a funnel-shaped de-

formity of the latter. The clinical picture and history were those of intraocular tumor. This is a rare condition. Nine cases were found in the literature.

G. D. Theobald.

Pajtas, Jozo. **Intravascular congenital hemangioendothelioma of the right eyelids.** Ceskoslovenska Ofthalmologie, 1933, v. 1, No. 3, pp. 139-144.

A female new-born had a neoplastic infiltration of the right eyelids which progressed over a period of more than two months through the hard and soft palate to the root of the tongue. It was a cauliflower-like growth extending beyond the skin surface; elastic to touch, dark red to purple violet in color. Growth was rapid and painless and presented the characteristics of a free orbital endothelioma. The eyeball was intact; there was neither dislocation of the bulb nor exophthalmos; and the bone was not eroded. The growth had the characteristics of a malignant tumor: spread by continuity, recurred, and metastasized—even while receding under treatment. Following energetic radium treatment given periodically for nine months, primary growth and metastases alike disappeared and were replaced by puckery scars. Histologic examination showed a very malignant tumor which was classified as intravascular hemangioendothelioma.

G. D. Theobald.

NEWS ITEMS

News items should reach the Editor by the twelfth of the month.

Deaths

Dr. William Campbell Posey, of Radnor, Pennsylvania, aged 68 years, died suddenly of cerebral hemorrhage on September 5, 1934, just after boarding the S. S. Rex at Naples, Italy.

Dr. Jay Clarence Knipe, of Philadelphia, aged 65 years, died suddenly September 9, 1934.

Miscellaneous

The University of Vienna offers the following courses in ophthalmology for the year 1934-1935, from September to August: Dr. Rudolf Bergmeister, tuberculosis and diseases of the eye; Dr. Josef Böck, slitlamp studies, muscle operations and operations on pig eyes; Dr. Adalbert Fuchs, internal medicine and the eye, and histopathology of the eye; Dr. Gustav Guist, pathology and therapy, ophthalmoscopy; Dr. Wilhelm Kreibig, diagnosis and therapy, plastic operations and histopathology; Dr. Karl Safar retinal detachment.

Professor L. Hirshman, Memorial Ukrainian State Ophthalmic Research Institute, U.S.S.R., held a series of scientific conferences in connection with the 25 years jubilee of the Professor L. Hirshman Memorial Eye Hospital which was reorganized in 1930 as a Research Ophthalmic Institute. The papers read on these conferences and other articles dedicated to the 25 years jubilee will be published in one volume. Oculists and members of other medical branches were cordially invited to partake in these ophthalmological conferences. The first conference took place in the Ophthalmic Institute's Auditorium, 5 Pravda Street, Kharkov, September 1, 1934.

The clinical teaching in ophthalmology for undergraduates at the University of Southern California Medical School will now be done in the new Los Angeles General Hospital with the aid of material supplied by the Eye Staff of that hospital. The chief of one service is Dr. L. A. J. LaMotte, associate professor of clinical surgery (ophthalmology) in the University of Southern California Medical School and the chief of the other service is William A. Boyce, professor of ophthalmology at the College of Medical Evangelists.

Societies

The officers of the Kansas City Eye, Ear, Nose and Throat Society are: Dr. Raymond Teall, president; Dr. Joseph McKee, first vice-president; Dr. T. D. Blasdel, second vice-president; Dr. A. W. McAlister, III, secretary; Dr. John S. Knight, treasurer; Dr. Alvin J. Baer, editor; Dr. Harold B. Hedrick, assistant editor.

At the meeting of the State Medical Society of New York, Dr. Webb W. Weeks of New York City was elected chairman of the section of Ophthalmology and Oto-Laryngology and Dr. John F. Fairbairn of Buffalo was elected secretary.

The Officers of the Chicago Ophthalmological Society for the coming year are: Dr. E. V. L. Brown, president; Dr. Thomas D. Allen, secretary. The Society meets the third Monday of the month, from October to May.

The Pan-American Medical Association, Seattle Chapter, gave a complimentary dinner to Dr. Charles Pierre Mathe, vice-president of the Pan-American Medical Association at the Washington Athletic Club, Seattle, Tuesday, September fourth. This Association has a membership of some 6,000 North American and South American physicians and surgeons. The next general meeting is a "floating congress" to several ports of South America and the following meeting will be held at the Mayo Clinic in Rochester, Minn. The following officers were elected for the Seattle Chapter: Dr. Harry Vanderbilt Würdemann, president, Dr. H. Gerner Wright, vice-president, Dr. Alexander H. Peacock, secretary, Dr. Donald V. Trueblood, treasurer. The meetings will be held for the furtherance of medical, economic and political relations with the United States, Canada, and the countries of Central and South America.

The election of Mason H. Bigelow and George C. Clark, both of New York City, to the Executive Committee of the National Society for the Prevention of Blindness, is announced by Lewis H. Carris, Managing Director. Mr. Clark has also been selected by the Board of Directors to be Treasurer of the Society, succeeding the late George Blagden.

Dr. Edward Jackson, of Denver, Colo., Consulting Editor of this Journal, has accepted membership on the Society's Board of Directors; Dr. Percy W. Cobb, Associate Professor of Applied Biophysics in Ophthalmology in the Medical School of Washington University, St. Louis, Mo., has joined the Board of Editors of the Society's quarterly journal, The Sight-Saving Review.

The following officers were elected at the annual meeting of the American Academy of Ophthalmology and Oto-Laryngology; Dr. Wells P. Eagleton, Newark, N.J., president; Dr. Frank Burch, Saint Paul, president-elect; Dr. William Thornwall Davis, Washington, D.C., first vice-president; Dr. Sam Iglauer, Cincinnati, second vice-president; Dr. F. Morie Weymann, Los Angeles, third vice-president. The secretarial group was re-elected. Dr. Robert Forgrave of Saint Joseph, Missouri, was the new member elected to the Council. The 1935 meeting will be held in Cincinnati.

Personals

Dr. Wendell Steele opened an office in the University Club Building, Saint Louis, on August 20th, 1934.

Dr. A. Ray Irvine, with Mrs. Irvine, is making a three weeks trip east during which he intends to visit Boston and see his son, Dr. Rod Irvine, who is obtaining his ophthalmological training at the Massachusetts Eye and Ear Infirmary. On the return trip he attended the Chicago meeting of the American Academy of Ophthalmology and Oto-Laryngology.

Dr. John O. McReynolds of Dallas, Texas, was the guest of the Research Study Club at a dinner meeting in Los Angeles on Monday, August 13th, at which time he spoke on "Some phases of the cataract problem in relation to general medicine and oto-laryngology." Motion pictures of cataract operative procedures were also demonstrated by Dr. McReynolds.

Dr. Hans Lauber of Warsaw, Poland, was entertained by the Research Study Club of Los Angeles at a dinner meeting on August 20th, at which time he spoke of the work in his clinic concerning the retinal circulation and its relation to intracranial pressure. There was also a delightful discussion on nonmedical subjects by Dr. Lauber and some of his former students who were present.